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ภาคผนวก ก.

Source Code สำหรับโปรแกรมคอมพิวเตอร์

```
PROGRAM CLD
C.....
      REAL MF,NB,NF,NUMBER,OVERALL
      CHARACTER NAME*12
      COMMON /CYC_S/ MODEC,APPL,TYPE,Dc,a,b,De,S,h1,H,BB
      COMMON /INLET_C/ NB,MF(50),dpi(50),Q_total,PARTICLE,TEMP
     + ,DUST,STAND,DP_(50)
      COMMON /APPL2/ NUMBER,D,PD,OVERALL
      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      COMMON /FAN_S/ MODEF,M_TYPE,np,DF(50),WF(50),AF(50),NF(50)
     + ,Q(50),DP(50),P(50)
      COMMON /FAN_SF/ NSF,DSF(10),WSF(10),ASF(10),QMIN(10)

      CALL READ_INP()
   10 WRITE(6,20)
   20 FORMAT(/,2X,'PLEASE ENTER OUTPUT FILE NAME :',/)
      READ(5,'(A)',ERR=10) NAME
      OPEN (UNIT=11, FILE=NAME, STATUS='NEW', ERR=10)

      CALL  CONFIGUATION(a,b,De,S,h1,H,BB,DC,G)

      WRITE(11,50) Q_total,TEMP,PARTICLE,DUST,STAND,NB
   50 FORMAT(//,10X,' COMPUTER PROGRAM FOR CYCLONE DESIGN',/
     +      ,4X,50('-'),8X,/,8X,'INLET CONDITION :',/
     +      ,8X,'VOLUMETRIC FLOW RATE',4X,F5.2,3X,'m^3/sec',/
     +      ,8X,'INLET TEMPERATURE',7X,F5.1,3X,'celsius',/
     +      ,8X,'PARTICLE DENSITY',8X,F6.1,2X,'kg/m^3',/
     +      ,8X,'DUST RATE',15X,F5.2,3X,'g/s',/
     +      ,8X,'STANDARD AIR POLLUTION',2X,F3.2,5X,'g/m^3',/
     +      ,8X,'PARTICLE SIZE DISTRIBUTION',/
     +      ,8X,'NUMBER OF DATA',3X,F4.1,/,9X,'SIZE (m.)'
     +      ,4X,'MASS FRACTION')
      DO 30 I=1,NB
      WRITE(11,51) dpi(i),MF(i)
   51 FORMAT(8X,E10.5,5X,F5.1)
   30 CONTINUE

     IF (MODEC.EQ.1) THEN
        DC = D
        IF (APPL.EQ.1) THEN
           GOTO 100
        ELSE IF (APPL.EQ.2) THEN
                 GOTO 200
        ELSE IF (APPL.EQ.3) THEN
                 GOTO 300
        ELSE IF (APPL.EQ.4) THEN
                 GOTO 400
        ELSE IF (APPL.EQ.5) THEN
                 GOTO 500
        ELSE IF (APPL.EQ.6) THEN
                 GOTO 600
        ELSE
        WRITE(*,*) " SELECT MODE AGAIN "
       ENDIF

C..... FLUID DENSITY AT STANDARD TEMPERATURE AND PRESSURE
C..... AT 20 CELSIUS DEGREES AND 1 ATM. (GRAM PER CUBIC METER)
       FLUID_DEN = (28.96/22400)*(293/(273 + TEMP))

C..... [Number of cyclones,Cyclone diameter]
  100 Qi = QV(Q_TOTAL,NUMBER)
       Vi = VEL(Qi,Dc,a,b)
       CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
       CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
       GOTO 700

C..... [Number of cyclones,Press drop]
  200 Qi = QV(Q_TOTAL,NUMBER)
       Vi = V(PRESS_D,FLUID_DEN,a,b,De)
       Dc = ( Qi/(a*b*Vi))**0.5
       CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,
     +                             OVERALL)
       GOTO 700

C..... [Cyclone diameter,Pressure drop]
  300 Vi = V(PRESS_D,FLUID_DEN,a,b,De)
       Qi = Q_(a,b,Vi,Dc)
```

```
      NUMBER = Q_total/Qi
      NUMBER = ANINT(NUMBER)
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      GOTO 700

C..... [Number of cyclones,Overall efficiency]
 400 Qi = QV(Q_TOTAL,NUMBER)
      DO 420 Dc = 0.1,3.,0.001
      Vi = VEL(Qi,Dc,a,b)
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      TOL = ABS( (OVERALL - OVER_ES)/OVERALL )
      ES  = 0.0001

      IF (TOL.GT.ES) THEN
        GO TO 420
      ELSE
        CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
        GO TO 700
      ENDIF
 420 CONTINUE

C..... [Cyclone diameter,Overall efficiency]
 500 DO 520 Vi = 3.0,100.0,0.01
      Qi = a*b*Vi*(Dc**2.)
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      TOL = ABS( (OVERALL - OVER_ES)/OVERALL )
      ES = 0.0001
      IF (TOL.GT.ES) THEN
        GO TO 520
      ELSE
        CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
        NUMBER = Q_total/Qi
        NUMBER = ANINT(NUMBER)
        GO TO 700
      ENDIF
 520 CONTINUE

C..... [Overall efficiency,Pressure drop]
 600 Vi = V(PRESS_D,FLUID_DEN,a,b,De)
      DO 620 Dc = 0.1,3.,0.001
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      TOL = ABS( (OVERALL - OVER_ES)/OVERALL )
      ES  = 0.0001
      IF (TOL.GT.ES) THEN
        GO TO 620
      ELSE
      NUMBER = Q_total/Qi
      NUMBER = ANINT(NUMBER)
      GO TO 700
      ENDIF
 620 CONTINUE

      ELSE IF (MODEC.EQ.2) THEN
C..... CHECK CONSTRAINS
      l  = 2.3*De*(Dc**2./(a*b))**(1./3.)
       IF ((a.LE.S).AND.(b.LT.(Dc-De)/2.)) THEN
         IF (((S+l).LE.H).AND.(S.LT.h1)) THEN
            IF (h1.LT.H) THEN
            ENDIF
         ENDIF
      ELSE
      WRITE(11,601)
 601 FORMAT(8X, '<< THIS GEOMETRY CYCLONE OUT OFF CONSTRAINS >>')
      ENDIF

      WRITE(11,602) Dc,a,b,De,S,h1,H,BB
 602 FORMAT(8X,'NOMENCLATURE CONSIST OF :',/
    +          ,8X,'BODY DIAMETER. Dc',5X,F5.3,2X,'m.',/,8X
    +          ,'INLET HEIGHT, a',7X,F5.3,2X,'m.',/,8X,'INLET WIDTH, b'
    +          ,8X,F5.3,2X,'m.',/,8X,'OUTLET DIAMETER, De',3X,F5.3,2X,'m.'
    +          ,/,8X,'OUTLET LENGTH, S',6X,F5.3,2X,'m.',/,8X
    +          ,'CYLINDER HEIGHT, h',4X,F5.3,2X,'m.',/,8X
    +          ,'OVERALL HEIGHT, H',5X,F5.3,2X,'m.',/,8X
    +         ,'DUST OUTLET DIA., B',3X,F5.3,2X,'m.',/,8X
    +         ,'(Note:  GEOMETRY CYCLONE DEFINE BY USER)')
      a  = a/Dc
      b  = b/Dc
```

```
      De = De/Dc
      dpi(1) = 2*dpi(1)
      Vi = VEL(Q_TOTAL,Dc,a,b)
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
      WRITE(11,603) OVERALL,PD
 603 FORMAT(8X,'OVERALL EFFICIENCY',4X,F5.2,2X,'%',/,8X,'PRESSURE DROP'
  +            ,9X,F5.2,2X,'cm. water')

      ELSE IF (MODEC.EQ.3) THEN
              CALL TRIAL(a,b,De,dpm,G,Dc,NUMBER,PD,OVERALL)
       a  = a*Dc
       b  = b*Dc
       De = De*Dc
       S  = S*Dc
       h1 = h1*Dc
       H  = H*Dc
       BB = BB*Dc
       WRITE(11,604) NUMBER,Dc,a,b,De,S,h1,H,BB,OVERALL,PD
 604    FORMAT(8X,'NUMBER OF CYCLONE',3X,F3.1,2X,'UNITS',/
  +              ,8X,'BODY DIAMETER, Dc',5X,F5.3,2X,'m.',/,8X
  +              ,'INLET HEIGHT, a',7X,F5.3,2X,'m.',/,8X,'INLET WIDTH, b'
  +              ,8X,F5.3,2X,'m.',/,8X,'OUTLET DIAMETER, De',3X,F5.3,2X,'m.'
  +              ,/,8X,'OUTLET LENGTH, S',6X,F5.3,2X,'m.',/,8X
  +              ,'CYLINDER HEIGHT, h',4X,F5.3,2X,'m.',/,8X
  +              ,'OVERALL HEIGHT, H',5X,F5.3,2X,'m.',/,8X
  +              ,'DUST OUTLET DIA., B',3X,F5.3,2X,'m.',/,8X
  +              ,'OVERALL EFFICIENCY',4X,F5.2,2X,'%',/,8X
  +              ,'PRESSURE DROP',9X,F5.2,2X,'cm. water')
       ENDIF


 700 CONTINUE
      Dc = DC
      a  = 0.5*Dc
      b  = 0.2*Dc
      De = 0.5*Dc
      S  = 0.5*Dc
      h1 = 1.5*Dc
      H  = 4.0*Dc
      BB = 0.375*Dc
      IF (MODEC.EQ.1.) THEN
         WRITE(11,605) NUMBER,Dc,a,b,De,S,h1,H,BB,OVERALL,PD
 605 FORMAT(8X,'NUMBER OF CYCLONE',3X,F3.1,2X,'UNITS',/
  +            ,8X,'BODY DIAMETER, Dc',5X,F5.3,2X,'m.',/,8X
  +            ,'INLET HEIGHT, a',7X,F5.3,2X,'m.',/,8X,'INLET WIDTH, b'
  +            ,8X,F5.3,2X,'m.',/,8X,'OUTLET DIAMETER, De',3X,F5.3,2X,'m.'
  +            ,/,8X,'OUTLET LENGTH, S',6X,F5.3,2X,'m.',/,8X
  +            ,'CYLINDER HEIGHT, h',4X,F5.3,2X,'m.',/,8X
  +            ,'OVERALL HEIGHT, H',5X,F5.3,2X,'m.',/,8X
  +            ,'DUST OUTLET DIA., B',3X,F5.3,2X,'m.',/,8X
  +            ,'OVERALL EFFICIENCY',4X,F5.2,2X,'%',/,8X
  +            ,'PRESSURE DROP',9X,F5.2,2X,'cm. water')
      ENDIF

C.....THIS PART WILL CAL. STANDARD AIR POLLUTION
C.....CHECK STANDARD AIR POLLUTION
      IF (DUST.EQ.0) THEN
         DUST = (STAND*Q_total)/(1-(OVERALL/100.))
         WRITE(11,701) DUST
 701    FORMAT(8X,'DUST RATE',3X,F5.2,2X,'g/s',2X,'(NOT MORE THAN)')
         GOTO 900
     ELSE
         AIRQ = (1-(OVERALL/100.))*DUST/Q_total
         IF (MODEC.EQ.3.) GOTO 750
            WRITE(11,702) AIRQ
 702   FORMAT(8X,'GRAIN LOADING EMISS AMBIENT'2X,F5.2,2X,'g/m^3')
        GOTO 900
 750 CONTINUE
      IF (AIRQ.LE.STAND) THEN
         WRITE(11,703) AIRQ
 703     FORMAT(8X,'GRAIN LOADING EMISS AMBIENT'2X,F5.2,2X,'g/m^3')
         GOTO 900
      ELSE
         OVERALL = (DUST-(STAND*Q_total))*100./DUST
         OVER_ES = OVERALL
      DO 810 Vivs = 1.25,1.36,0.001
```

```
      DO 811 Dc =0.3,3.0,0.001
      fluid_den = (28.96/22400)*(293/(273 + TEMP))*1000
      Va = 1.1*100*( 9.81*VISCOUS(TEMP)*(PARTICLE - FLUID_DEN )
     +                / FLUID_DEN**2. )**(1./3.)
      Vi = ( 0.228*Va*((b**0.4)/(1.-b)**(1./3.))*(Dc**0.067)
     +       *(ViVs) )**3.
      Vi = Vi/100.
      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)

      TOL = ABS( (OVERALL - OVER_ES)/OVERALL )
      ES  = 0.0001
      IF (TOL.GT.ES) THEN
         GO TO 811
      ELSE
         GO TO 812
      ENDIF

 811  CONTINUE
 810  CONTINUE
        ENDIF
       ENDIF
 812  Qi = a*b*Vi*(Dc**2.)
       NUMBER = Q_total / Qi
       NUMBER = ANINT(NUMBER)
       Qi = Q_total / NUMBER
       Dc = SQRT(Qi/(a*b*Vi))
       airq = stand
       CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
 900  CONTINUE

C.....COVERT QMAX [m^3/s -> cfm]
      QMAX = Q_total*35.315*60
      PMAX = PD
      CALL FAN(TEMP,PS,PSMAX)

      STOP
      END


      SUBROUTINE READ_COM()
C   ==================================================================
C   |                                                                |
C   | THIS SUBROUTINE WILL ELIMINATE THE COMMENT ON THE INPUT FILE   |
C   | IT READ "<" AS A BEGINING SIGN OF COMMENT AND ">" AS THE END   |
C   |                                                                |
C   ==================================================================

C.....ASSIGN VARIABLES
C.....FIRST AS THE FIRST CHARACTER OF LINE

      CHARACTER FIRST

    5  READ(10,'(A)',END=1000) FIRST
       IF ( FIRST.EQ.' ' ) GO TO 5
       IF ( FIRST.NE.'<' ) GO TO 1000
   10  READ(10,' (A) ',END=1000) FIRST
       IF ( FIRST.NE.'>' ) GO TO 10
 1000 CONTINUE
       RETURN
       END


      SUBROUTINE READ_INP()
C   ==================================================
C   |                                                |
C   | THIS SUBROUTINE WILL READ DATAS FOR INPUT FILE. |
C   |                                                |
C   ==================================================

       REAL M,MF,NF,NP,NB,NUMBER,OVERALL
       COMMON /MODE/ MODE
       COMMON /APPL2/ NUMBER,D,PD,OVERALL
       COMMON /CYC_S/ MODEC,APPL,TYPE,Dc,a,b,De,S,h1,H,BB
       COMMON /INLET_C/ NB,MF(50),dpi(50),Q_total,PARTICLE,TEMP
     + ,DUST,STAND,DP_(50)
       COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
       COMMON /FAN_S/ MODEF,M_TYPE,NP,DF(50),WF(50),AF(50),NF(50)
```

```
   + ,Q(50),DP(50),P(50)
     COMMON /FAN_SF/ NSF,DSF(10),WSF(10),ASF(10),QMIN(10)
     DIMENSION X(8)

    OPEN (UNIT=10, FILE='DATA', STATUS='OLD')
C.....PART I : READ CYCLONE DATA FROM INPUT FILE
     CALL READ_COM()
     CALL READ_COM()
     READ(10,*) MODEC
     MODE = MODEC
     IF (MODEC.EQ.1) THEN
C.....READ APPLICATION CASE FOR CYCLONE
C.....APPLICATION AND TYPE
      READ(10,*) APPL,TYPE
C.....CASE 1 : ENTER [Number of cyclones,Cyclone diameter]
     IF (APPL.EQ.1.) THEN
        READ(10,*) NUMBER,D

C.....CASE 2 : ENTER [Number of cyclones,Press drop]
     ELSE IF (APPL.EQ.2.) THEN
              READ(10,*) NUMBER,PD

C.....CASE 3 : ENTER [Cyclone diameter,Pressure drop]
     ELSE IF (APPL.EQ.3.) THEN
              READ(10,*) D,PD

C.....CASE 4 : ENTER [Number of cyclones,Overall efficiency]
     ELSE IF (APPL.EQ.4.) THEN
              READ(10,*) NUMBER,OVERALL

C.....CASE 5 : ENTER [Cyclone diameter,Overall efficiency]
     ELSE IF (APPL.EQ.5.) THEN
              READ(10,*) D,OVERALL

C.....CASE 6 : ENTER [Overall efficiency,Pressure drop]
     ELSE IF (APPL.EQ.6.) THEN
              READ(10,*) OVERALL,PD
    ENDIF
      GOTO 5

     ELSE IF (MODEC.EQ.2) THEN
C.....READ GEOMETRY CYCLONE
     DO 1 I=1,8
     READ(10,*) X(I)
  1  CONTINUE
     Dc = X(1)
      a  = X(2)
      b  = X(3)
      De = X(4)
      S  = X(5)
      h1 = X(6)
      H  = X(7)
      BB = X(8)

     ELSE IF (MODEC.EQ.3) THEN
C.....READ TPYE CYCLONE
     READ(10,*) TYPE
       GOTO 5
     ENDIF
  5  IF (TYPE.EQ.1) THEN
C.....CYCLONE TYPE HIGH EFFICIENCY, MEDIUM THROUGHPUT
C.....BY STAIRMAND DESIGN
     Dc = 1.
     a  = 0.5*Dc
     b  = 0.2*Dc
     De = 0.5*Dc
     S  = 0.5*Dc
     h1 = 1.5*Dc
     H  = 4.0*Dc
     BB = 0.375*Dc
     ELSE IF (TYPE.EQ.2) THEN
C.....CYCLONE TYPE MEDIUM EFFICIENCY, HIGH THROUGHPUT
C.....BY STAIRMAND DESIGN
      Dc = 1
      a  = 0.75*Dc
      b  = 0.375*Dc
      De = 0.75*Dc
```

```
      S  = 0.875*Dc
      hl = 1.5*Dc
      H  = 1.0*Dc
      BB = 0.375*Dc
      ENDIF

C.....READ INLET CONDITION FOR CYCLONE
      CALL READ_COM()
      READ(10,*) NB
      M = NB/6.
      M = ANINT(M)
      DO 20 I=1,M
       J = I + (I-1)*5
       READ(10,*) MF(J),MF(J+1),MF(J+2),MF(J+3),MF(J+4),MF(J+5)
   20  CONTINUE
       DO 30 I=1,M
       J = I + (I-1)*5
       READ(10,*) DP_(J),DP_(J+1),DP_(J+2),DP_(J+3),DP_(J+4),DP_(J+5)
   30  CONTINUE
       DO 40 I=1,NB
       DPi(I) = (DP_(I)+DP_(I+1))/2./1000000.
   40  CONTINUE

       READ(10,*) Q_total
       READ(10,*) PARTICLE
       PARTICLE = PARTICLE*1000
       READ(10,*) TEMP
       READ(10,*) DUST
       READ(10,*) STAND

C.....PART II : READ FAN DATA FROM INPUT FILE
       CALL READ_COM()
       READ(10,*) MODEF
       IF (MODEF.EQ.2) THEN
          READ(10,*) NP
       DO 50 i=1,NP
          READ(10,*) DF(i),WF(i),AF(i),NF(i),Q(i),DP(i),P(i)
   50 CONTINUE
       READ(10,*) NSF
       DO 60 j=1,NSF
           READ(10,*) DSF(j),WSF(j),ASF(j),QMIN(j)
   60 CONTINUE
      ELSE
      IF (MODEF.GT.2) THEN
       WRITE(*,*) " MODE  INCORRECT "
       STOP
       ENDIF
      ENDIF
     CLOSE(10)

     RETURN
     END


     SUBROUTINE CONFIGUATION(a,b,De,S,h1,H,BB,DC,G)
C   ================================================================
C   |                                                              |
C   | AFTER THE DESIGN RATIOS HAVE BEEN DETERMINED, THE CONFIGUATION |
C   | FACTOR,G MUST BE CALCULATED IN ORDER TO OBTAIN GRADE EFFICIENCY |
C   |                                                              |
C   ================================================================
C.....ASSIGN VARIABLES
C      d  : DIAMETER OF CENTRAL CORE AT POINT WHERE VORTEX TURN
C     Ka  : INLET HEIGHT RATIO
C     Kb  : INLET WIDTH RATIO
C     Kc  : CYCLONE VOLUME CONSTANT
C      l  : NATURAL LENGTH (DISTANCE BELOW GAS OUTLET WHERE
C           VORTEX TURNS)
C     VH  : VOLUME BELOW EXIT DUCT (EXCLUDING CORE)
C     Vnl : VOLUME AT NATURAL LENGTH (EXCLUDING CORE)
C     Vs  : ANNULAR VOLUME ABOVE EXIT DUCT TO MIDDLE OF ENTRANCE

      REAL Ka,Kb,Kc,l

      PI = 4.*ATAN(1.)
      l  = 2.3*De*((DC**2.)/(a*b))**(1./3.)
      d  = DC - (DC - BB)*((S+l-h1)/(H-h1))
```

```
C    CAL. THE CYCLONE VOLUME AT THE NATURAL LENGTH, Vnl
      Vnl = ((PI*(DC**2.)/4.)*(h1-S) + (PI*(DC**2.)/4.)*((l+S-h1)/3.)*
   +        (1. + d/DC + (d/DC)**2.) - (PI*(De**2.)*l/4.))

C    CAL. CYCLONE VOLUME BELOW THE EXIT DUCT, VH
      VH = (((PI*(DC**2.))/4.)*(h1-S) + (PI*(DC**2.)/4.)*((H-h1)/3.)*
   +        (1. + BB/DC + (BB/DC)**2.) - (PI*(De**2.)/4.)*(H-S))

C    CAL. THE CYCLONE VOLUME CONSTANT, Kc
      VS = (PI*(S - (0.5*a))*(DC**2. - De**2.)/4.)

      IF  ( l.LT.(H-S) )  THEN
          Kc = (2.*VS + Vnl)/(2.*(DC**3.))
      ELSE
         IF  ( l.GT.(H-S) )  THEN
            Kc = (2.*VS + VH)/(2.*(DC**3.))
         ENDIF
      ENDIF

      Ka = a/DC
      Kb = b/DC
      Kc = Kc

C.....CONFIGUATION FACTOR (G)
      G = (8.*Kc)/((Ka**2.)*(Kb**2.))

      RETURN
      END


     SUBROUTINE OVERALL_EFF(a,b,Dc,dpi,MASS,G,NB,Vi,TEMP,PARTICLE,
   +                                   OVERALL)
C.....ASSIGN VARIABLES
C    DP()        : PARTICLE SIZE, EQUIVALENT AERODYNAMIC SHPERICAL DIA.
C    EFF()       : GRADE EFFICIENCY FOR PARTICLE SIZE AT MID-POINT OF
C                 INTERVAL i,%
C    F_DEN       : DENSITY CORRECTION FACTOR FOR SALTATION VELOCITY
C    F_TEMP      : TEMPERATURE CORRECTION FACTOR FOR SALTATION VELOCITY,
C    MASS        : MASS FRACTION,%
C    nn          : VORTEX EXPONENT
C    NUMBER      : NUMBER OF CYCLONES
C    OVERALL_EFF : OVERALL EFFICIENCY,%
C    Qi          : FLOWRATE TO EACH CYCLONE(actual),m^3/s
C    Q_TOTAL     : TOTAL GAS FLOW RATE(actual),m^3/s
C    RELAX()     : RELAXATION TIME,sec
c    Va          : GAS PATH VELOCITY,m/s
C    Vi          : INLET VELOCITY,m/s
C    Vs          : SALTATION VELOCITY,m/s

      REAL nn,NB,OVERALL,MASS
      DIMENSION DPi(100),MASS(100),RELAX(100),GRADE_EFF(100),EFF(100)
      DO 150 I=1,NB
C.....RELAXATION TIME
      RELAX(I) = PARTICLE*(DPi(I)**2.)/(18*VISCOUS(TEMP))
      V = VISCOUS(TEMP)
C.....VORTEX EXPONENT
      nn = 1 - (1-0.669*(DC**0.14))*((TEMP+273)/293)**0.3
C.....FRACTION EFFICIENCY
      EFF(I) = 1 - EXP( -2*( G*RELAX(I)*a*b*Vi*(DC**2.)*(nn+1.)
   +                   /DC**3.)**(0.5/(nn+1.)) )
  150 CONTINUE
      OVERALL = 0.
      DO 140 J=1,NB
      GRADE_EFF(J) = MASS(J)*EFF(J)
      OVERALL = OVERALL + GRADE_EFF(J)
  140 CONTINUE
      RETURN
      END

      SUBROUTINE PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)
C    ===================================================================
C    |                                                                 |
C    |   CYCLONE PRESSURE DROP ESTIMATED BY SHEPHERD AND LAPPLE.       |
C    |  ACCEPTABLE LEVELS OF PRESSURE DROP FOR CYCLONE OPERATION       |
C    |  ARE GENERALLY LESS THAN 25 CM WATER.                           |
C    |                                                                 |
C    ===================================================================
```

```
C.....ASSIGN VARIABLES
C         PD :  PRESSURE DROP, centrimeter water
C    FLUID_DEN  :  FLUID DENSITY OR GAS DENSITY, gram per cu. meter
C         a  :  INLET LENGTH, m
C         b  :  INLET WIDTH, m
C         De  :  OUTLET DIAMETER, m
C         Vi  :  INLET VELOCITY, m/s

      REAL NUMBER,K
      COMMON /MODE/ MODE
C.....FLUID DENSITY AT STANDARD TEMPERATURE AND PRESSURE
C.....AT 20 CELSIUS DEGREES AND 1 ATM. (GRAM PER CUBIC METER)
      FLUID_DEN = (28.96/22400)*(293/(273 + TEMP))

C.....FOR NEUTRAL VANE
       K = 16
C.....MULTIPLY 10000 FOR PRESSURE DROP CONVERT TO CENTIMETER WATER UNIT
       PD = 5.12E-04*FLUID_DEN*(Vi**2.)*K*(a*b/De**2.)*10000

      IF (MODE.LE.3) GOTO 5
      IF (PD.GT.25) THEN
          PD = 25.
          Vi = ( PD*1953.125*(De**2./(a*b))
     +           / FLUID_DEN )**(1./2.)
          Qi = a*b*Vi*(Dc**2.)
          NUMBER = Q_total / Qi
          NUMBER = ANINT(NUMBER)
          Qi = Q_total / NUMBER
          Dc = SQRT(Qi/(a*b*Vi))
          PD = 8.19E-03*FLUID_DEN*(Vi**2.)*(a*b/De**2.)
       ELSE
       ENDIF
    5  RETURN
       END


      SUBROUTINE TRIAL(a,b,De,dpm,G,Dc,NUMBER,PD,OVERALL)
C     ================================================================
C     |                                                              |
C     | THIS PROCEDURE CONVERGES TO OPTINUM PERFORMMANCE WITH        |
C     | WITH MINMUM NUMBER.                                          |
C     |                                                              |
C     ================================================================
C.....CALCULATE CORRECTION FOR EFFICIENCY
C.....INLET CONDITION BASE FOR STAIRMAND CYCLONE
      REAL OVER_ES,OVERALL,MF,MASS,MASSF,MASSC,MASSS,NUMBER,N,NB,LOGMF
      COMMON /ESTI/ C(9)
      COMMON /INLET_C/ NB,MF(50),dpi(50),Q_total,PARTICLE,TEMP
     + ,DUST,STAND,DP_(50)
       DIMENSION COF(50,50),DP(50),DPS(10),DPF(12),DPC(11),LOGMF(100)
     + ,MASSS(10),MASSF(12),MASSC(11),MASS(12),MM(50)
      DATA MASSS/1,2,1,1,1,4,4,10,19,56/
      DATA DPS/75,60,40,30,20,15,10,7.5,5,.97/
      DATA MASSF/3,7,10,15,10,10,7,8,4,6,8,12/
      DATA DPF/150,104,75,60,40,30,20,15,10,7.5,5,1.25/
      DATA MASSC/54,6,8,5,6,5,4,3,3,3,3/
      DATA DPC/104,75,60,40,30,20,15,10,7.5,5,2.5/

C.....FIND MEAN DIAMETER,dpm
      SUM = 0.
      DO 222 I=NB,1,-1
      SUM = SUM + MF(I)
      IF (SUM.GE.50) THEN
         SUMUP = SUM
         SUMLOW = SUM - MF(I)
         SIZEUP = DP_(I)
         SIZELOW = DP_(I+1)
         DB = 50 - SUMLOW
         DSUM  = MF(I)
         DSIZE = DP_(I) - DP_(I+1)
         DX  = (DB*DSIZE)/DSUM
         dpm = (DP_(I+1) + DX)/1000000
        GOTO 223
       ELSE
       ENDIF
  222 CONTINUE
```

```
 223 CONTINUE

C.....INTITIAL PROPERTY FOR CALCULATE
      Dc_b = 0.6096
      Vi_b = 24.38
      TEMP_b = 37.78
      PARTICLE_b = 2580
      EFF1 = CORRECT(PARTICLE_b,TEMP_b,G,a,b,Dc_b,Vi_b,dpm)

C.....FIND DENSITY CORRECTION FOR EFFICIENCY
      EFF2 = CORRECT(PARTICLE,TEMP_b,G,a,b,Dc_b,Vi_b,dpm)

C.....FIND TEMPERATURE CORRECTION FOR EFFICIENCY
      EFF3 = CORRECT(PARTICLE_b,TEMP,G,a,b,Dc_b,Vi_b,dpm)

      EFF_D = ABS(EFF1-EFF2)*100
      EFF_T = ABS(EFF1-EFF3)*100
      EFF_D = ANINT(EFF_D)

C.....CALCULATE VELOCITY RATIO, (Vi/Vs)
C.....CORRELATION FACTOR FOR DENSITY
C.....ERROR FROM BASE CONDITION (2.58 g/m^3)= -.04062
      F_d = 2.25/(3.11-LOG(PARTICLE/1000))*0.95938

C.....CORELATION FACTOR FOR TEMPERATURE
C.....ERROR FROM BASE CONDITION (38 CELSIUS)= .00035
      F_t = 6.88/(10.52-LOG(TEMP))*1.00035

      ViVs = 1.25/(F_t*F_d)
      OVER_ES = 86.7 + EFF_D + EFF_T
      MM(0) = 0
      DO 10 I=1,NB
           MM(I) = MM(I-1) + MF(NB-I+1)
           LOGMF(I) = LOG(MM(I))
           COF(I,1) = LOG(DPi(NB-I+1))
           COF(I,2) = LOG(DPi(NB-I+1))**2.
  10 CONTINUE
      K = 2
      CALL MREGRESS(NB,K,COF,C,LOGMF)
      CALL COMPARE(AEROSOL)

      IF (AEROSOL.EQ.1) THEN
         DO 61 I=1,10
         N = 10
         MASS(I) = MASSS(I)
         DP(I)   = DPS(I)/1000000.
  61     CONTINUE
      ELSE
        IF (AEROSOL.EQ.2) THEN
          DO 62 I=1,12
          N = 12
          MASS(I) = MASSF(I)
          DP(I)   = DPF(I)/1000000.
  62      CONTINUE
       ELSE
          DO 63 I=1,11
          N = 11
          MASS(I) = MASSC(I)
          DP(I)   = DPC(I)/1000000.
  63      CONTINUE
        ENDIF
      ENDIF

      DO 100 Dc =0.3,4.0,0.001
C.....APPROXIMATION OF GAS PATH VELOCITY,Va
      gra = 9.81
      fluid_den = 0.0699/0.062428
      Va = 1.1*100*( gra*VISCOUS(TEMP_B)*(PARTICLE_B - FLUID_DEN )
     +                / FLUID_DEN**2. )**(1./3.)
C.....INLET VELOCITY
      Vi = ( 0.228*Va*((b**0.4)/(1.-b)**(1./3.))*(Dc**0.067)
     +       *(ViVs) )**3.
      Vi = Vi/100.
      CALL OVERALL_EFF(a,b,Dc,dp,MASS,G,N,Vi,TEMP_B,PARTICLE_B,OVERALL)
      TOL = ABS( (OVERALL - OVER_ES)/OVERALL )
      ES  = 0.0001
```

```
      IF (TOL.GT.ES) THEN
        GO TO 100
      ELSE
        GO TO 130
      ENDIF

 100  CONTINUE
 130  Qi = a*b*Vi*(Dc**2.)
      NUMBER = Q_total / Qi
      NUMBER = ANINT(NUMBER)
      Qi = Q_total / NUMBER
      Dc = SQRT(Qi/(a*b*Vi))

      CALL OVERALL_EFF(a,b,Dc,dpi,MF,G,NB,Vi,TEMP,PARTICLE,OVERALL)
      CALL PRESSURE(a,b,De,Vi,NUMBER,TEMP,Q_total,PD)

      RETURN
      END


      SUBROUTINE COMPARE(AEROSOL)
C     ==================================================================
C     |                                                                |
C     | THIS SUBROUTINE WILL BE COMPARE PARTICLE SIZE DISTRIBUTION     |
C     | TO STAIRMAND'S THREE STANDARD AEROSOLS AND PICK THE STANDARD   |
C     | THAT MOST CLOSELY RESEMBLES THE ACRUAL AEROSOL                 |
C     |                                                                |
C     ==================================================================

      COMMON /ESTI/ C(9)
      DIMENSION MASSS(10),MASSF(12),MASSC(11),DP(12),SUMY(20),YF(20)
      DATA MASSS/56,75,85,90,94,95,96,97,99,100/
      DATA MASSF/12,20,26,30,38,45,55,65,80,90,97,100/
      DATA MASSC/3,6,9,12,16,21,27,32,40,46,54/
      DATA DP/2.5,5.,7.5,10,15,20,30,40,60,75,104,150/

      SUM = 0
C.....CALCULATE STANDARD DEVIATION OF ERROR(SDE) BETWEEN
C.....SUPERFINE DUST AND EXAMPLE
      DO 10 I=1,10
         YF(I) = FDP(DP(I)/1000000.)
         SUMY(I) = (YF(I)-MASSS(I)/1000000.)**2.
         SUM_S = SUMY(I) + SUM
  10  CONTINUE
      SDE_S = SQRT(SUM_S/9)

C.....CALCULATE STANDARD DEVIATION OF ERROR(SDE) BETWEEN
C.....FINE DUST AND EXAMPLE
      DO 20 I=1,12
         YF(I) = FDP(DP(I)/1000000.)
         SUMY(I) = (YF(I)-MASSF(I)/1000000.)**2.
         SUM_F = SUMY(I) + SUM
  20  CONTINUE
      SDE_F = SQRT(SUM_F/11)

C.....CALCULATE STANDARD DEVIATION OF ERROR(SDE) BETWEEN
C.....COARSE DUST AND EXAMPLE
      DO 30 I=1,11
         YF(I) = FDP(DP(I)/1000000.)
         SUMY(I) = (YF(I)-MASSC(I)/1000000.)**2.
         SUM_C = SUMY(I) + SUM
  30  CONTINUE
      SDE_C = SQRT(SUM_C/10)

      IF ((SDE_S.LE.SDE_F).AND.(SDE_S.LE.SDE_C)) THEN
C.....SUPERFINE DUST
        AEROSOL = 1.
      ELSE IF ((SDE_F.LE.SDE_S).AND.(SDE_F.LE.SDE_C)) THEN
C.....FINE DUST
        AEROSOL = 2.
      ELSE IF ((SDE_F.LE.SUM_S).AND.(SDE_F.LE.SUM_C)) THEN
C.....COARSE DUST
        AEROSOL = 3.
      ENDIF

      RETURN
      END
```

```
      SUBROUTINE MREGRESS(N,K,CK,XX,CN)
C    ==================================================================
C    |                                                                |
C    |    THIS SUBROUTINE WILL BE USED TO FIND OUT COEFFICIENTS OF    |
C    |    LINEAR EQUATION BY MULTIPLE LINEAR REGRESSION METHOD.       |
C    |                                                                |
C    ==================================================================

      DIMENSION X(100,10),Y(100),CN(100),CK(50,50)
      DIMENSION A(10,10),B(10),XX(9)
      REAL N
C.....READ NUMBER OF DATA SETS N,
C.....NUMBER OF INDEPENDENT VARIABLES K,
C.....AND DATA OF X(I,K) AND Y(I):

      DO 100 I=1,N
        DO 200 J=1,K
 200      X(I,J)=CK(I,J)
          Y(I)=CN(I)
 100   CONTINUE
      DO 300 IR=1,10
          B(IR) = 0.
          DO 300 IC=1,10
          A(IR,IC) = 0.
 300      CONTINUE

C.....COMPUTE SQUARE MATRIX ON LHS AND VECTOR ON RHS OF SYSTEM
C.....EQUATIONS:
C.....CALL SUBROUTINE FOR SOLVING SYSTEM EQS:
      DO 400 I=1,N
          DO 500 IR=1,K+1
             IF (IR.EQ.1) FR = 1.
             IF (IR.GT.1) FR = X(I,IR-1)
          DO 600 IC=1,K+1
             IF (IC.EQ.1) FC = 1.
             IF (IC.GT.1) FC = X(I,IC-1)
             A(IR,IC) = A(IR,IC)+FR*FC
 600         CONTINUE
        B(IR) = B(IR)+FR*Y(I)
 500      CONTINUE
 400    CONTINUE
       KP1=K+1
       CALL GAUSS(KP1,A,B,XX)

       RETURN
       END


      SUBROUTINE GAUSS(N,A,B,XX)
C    ==================================================================
C    |                                                                |
C    |     THIS SUBROUTINE WILL BE USED TO SOLVE LINEAR EQUATION      |
C    |     SYSTEM BY GAUSS ELIMINATION METHOD.                        |
C    |                                                                |
C    ==================================================================
      DIMENSION A(10,10),B(10),XX(9)

C.....FORWARD ELIMINATION: PERFORM ACCORDING TO THE ORDER OF 'PRIME'
C.....FROM 1 TO N-1:
       DO 100 IP=1,N-1
C.....LOOP OVER EACH EQUATION STARTING FROM THE ONE THAT CORRESPONDS
C.....WITH THE ORDER OF 'PRIME' PLUS ONE:
       DO 200 IE=IP+1,N
           RATIO = A(IE,IP)/A(IP,IP)
C.....COMPUTE NEW COEFF. OF THE EQ. CONSIDERED:
         DO 300 IC=IP+1,N
             A(IE,IC) = A(IE,IC)-RATIO*A(IP,IC)
 300         CONTINUE
             B(IE) = B(IE)-RATIO*B(IP)
 200      CONTINUE
C.....SET COEFF. ON LOWER LEFT PORTION TO ZERO:
       DO 400 IE=IP+1,N
          A(IE,IP) = 0.
 400      CONTINUE
 100    CONTINUE
```

```
C.....BACK SUBSTITUTION:
C.....COMPUTE SOLUTION OF THE LAST EQUATION:
      XX(N) = B(N)/A(N,N)
C.....COMPUTE SOLUTIONS FROM EQUATION N-1 TO 1:
      DO 500 IE=N-1,1,-1
        SUM = 0.
        DO 600 IC=IE+1,N
            SUM = SUM + A(IE,IC)*XX(IC)
 600        CONTINUE
        XX(IE) = (B(IE)-SUM)/A(IE,IE)
 500  CONTINUE

      RETURN
      END


      SUBROUTINE FAN(TEMP,PS,PSMAX)
C===================================================================
C===================== FAN PERFORMANEC CURVE =======================
C===================================================================
C   ESTABLISH FAN PERFORMANCE CURVE
C
C   CHOOSE 1:DEFAULT FAN CURVE (YORK, BI DWDI)
C
C.....ASSIGN VARIABLES
C       ANT      = COEFFICIENTS OF TOTAL MECHANICAL EFFICIENCY OF
C                  FAN EQUATION
C       ABE      = COEFFICIENTS OF EQUATION OF MEAN ANGLE AT WHICH
C                  GAS EXITS FROM FAN WHEEL
C       CFM,FA   = AIR FLOW RATE,cfm
C       RPM      = FAN ROTATIONAL SPEED,rpm
C       MIN_FLOW = MINIMUM ALLOWABLE AIR FLOW OF FAN,cfm
C       PEAK     = MAXIMUM AIR FLOW OF FAN,cfm
C       P_RISE   = STATIC PRESSURE GAIN,in H2O

      REAL NF,NP,NT,LOGNT,LOGBETA,LORANGE
      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      COMMON /FAN_S/ MODEF,M_TYPE,NP,DF(50),WF(50),AF(50),NF(50)
     + ,Q(50),DP(50),P(50)
      COMMON /FAN_SF/ NSF,DSF(10),WSF(10),ASF(10),QMIN(10)
      COMMON ICOUNT
      DIMENSION CO(50,50),GM(50),NT(100),BETA(100)
      DIMENSION LOGNT(100),LOGBETA(100)

C.....CONVERT UNIT TO ENGLISH UNIT(in WG.)
      PMAX = PMAX/2.54

C.....AMBIENT TEMPERATURE
      TEMP = 42.65
      ICOUNT = 1
      IF (ICOUNT.EQ.1) THEN

         IF (MODEF.EQ.1) THEN

C.....FAN'S CHARACTERISTIC OF DEFAULT FAN CURVE
        ANT(1) = -1.222786
        ANT(2) = -0.770037
        ANT(3) = -0.133004
        ABE(1) =  3.555767
        ABE(2) =  0.028082
        ABE(3) =  0.026111

C.....SELECTION OF FAN'S SIZE
C.....CRITERIA : 1. LOW FAN'S POWER CONSUMPTION
C               2. OPERATING POINT IS OUT OF SURGE REGION.

       DO 100 I=1,5
           IF (I.EQ.1) THEN
              D1 = 18.25
              W1 = 3.65
              A1 = 3.45
           QMIN1 = 2800
C.....CHECK MINIMUM AIRFLOW LIMIT FOR 18.25 BI DWDI
          IF (QMAX.LT.2800.) GOTO 100
          ELSE IF (I.EQ.2) THEN
              D1 = 16.50
              W1 = 3.30
```

```
          A1 = 2.82
        QMIN1 = 2200
C.....CHECK MINIMUM AIRFLOW LIMIT FOR 16.50 BI DWDI
        IF (QMAX.LT.2200.) GOTO 100
        ELSE IF (I.EQ.3) THEN
              D1 = 15.00
              W1 = 3.00
              A1 = 2.33
              QMIN = 1900
C.....CHECK MINIMUM AIRFLOW LIMIT FOR 15.00 BI DWDI
        IF (QMAX.LT.1900) GOTO 100
        ELSE IF (I.EQ.4) THEN
              D1 = 13.50
              W1 = 2.70
              A1 = 1.89
              QMIN1 = 1500
C.....CHECK MINIMUM AIRFLOW LIMIT FOR 13.50 BI DWDI
        IF (QMAX.LT.1500) GOTO 100
        ELSE IF (I.EQ.5) THEN
              D1 = 12.25
              W1 = 2.45
              A1 = 1.55
              QMIN1 = 1200
       ENDIF

C.....FIND RPM OF FAN SPEED FROM SUBROUTINE [VSD]
      CALL VSD(D1,W1,A1,TEMP,QMAX,PMAX,RPM,PS,PSMAX)

C.....FIND MAXIMUM OF AIR FLOW RATE (RANGE) THAT SPECIFIED FAN'S SIZE
C.....CAN BE OPERATING
C.....LET PEAK AS MAXIMUM AIR FLOW RATE OF FAN,CFM
        IM = 1
 200    FR = QMAX+200*IM
        CALL ESTABLSH(D1,W1,A1,TEMP,FR,RPM,P_RISE)
        IF (P_RISE.GT.0.25) THEN
           IM=IM+1
           GOTO 200
         ENDIF
         PEAK = FR*0.8


C.....DETERMINE FAN'S OPERATING RANGE FOR HIGH FAN MECHANICAL EFFICIENCY
        LORANGE = PEAK*0.6
        UPRANGE = PEAK*0.8

        IF ((QMAX.GT.LORANGE).AND.(QMAX.LT.UPRANGE)) GOTO 300
 100    CONTINUE

 300   CONTINUE
       ELSE

C   CHOOSE 2:FAN CURVE BY USER INPUT DATAS
C
C.....ASSIGN VARIABLES
C        BETA = MEAN ANGLE AT WHICH GAS EXITS FROM FAN WHEEL,rad.
C        EK   = KINETIC ENERGY GAIN/UNIT MASS,ft-lb-f/lb-m
C        EP   = POTENTIAL ENERGY GAIN/UNIT MASS,ft-lb-f/lb-m
C        ET   = TOTAL ENERGY GAIN PER UNIT MASS OF GAS,ft-lb-f/lb-m
C        GM   = EK/ET RATIO
C        NT   = TOTAL MECHANICAL EFFICIENCY,%
C        WSI  = SHAFT INPUT POWER,ft-lb-f/lb-m

C.....FIND TOTAL MECHANICAL EFFICIENCY AND MEAN ANGLE AT WHICH GAS
C.....EXITS FROM FAN WHEEL FROM USER'S INPUT FAN DATA SETS
        V = 1/RHO(TEMP)
        DO 500 I=1,NP
           EK = (Q(I)/AF(I))**2/231624.
           EP = 5.204*V*DP(I)
           ET = EP+EK
           EO = ((DF(I)*NF(I))**2.)/1698726.
           EB = (Q(I)*NF(I)/WF(I))/9650.
          GM(I) = EK/ET
          WSI = 33000.*(P(I)*V/Q(I))
           NT(I) = ET/WSI
           LOGNT(I) = LOG(NT(I))
           BETA(I) = (ATAN(EB/(EO-WSI))*180./(22./7.))
           LOGBETA(I) = LOG(ATAN(EB/(EO-WSI))*180./(22./7.))
```

```
          CO(I,1) = LOG(GM(I))
          CO(I,2) = LOG(GM(I))**2

 500      CONTINUE
        K=2
        CALL MREGRESS(NP,K,CO,ANT,LOGNT)
        CALL MREGRESS(NP,K,CO,ABE,LOGBETA)

C.....SECTION OF FAN'S SIZE BY USER
      DO 600 I=1,NSF
          D1 = DSF(i)
          W1 = WSF(i)
          A1 = ASF(i)
      IF (QMAX.LT.QMIN(i)) GOTO 600
          QMIN1 = QMIN(i)
          CALL VSD(D1,W1,A1,TEMP,QMAX,PMAX,RPM,PS,PSMAX)
          GOTO 650

 600 CONTINUE
 650 CONTINUE
        ENDIF
      ENDIF

      WRITE(11,700) D1,W1,A1,QMIN1,RPM,PS
 700 FORMAT(8X,'USE FAN :',/,8X,'FAN WHEEL DIAMETER',4X,F5.2,2X
   +          ,'inch',/,8X,'FAN TIP WIDTH',9X,F4.2,3X,'inch',/,8X
   +          ,'DISCHARGE AREA',8X,F4.2,3X,'ft^2',/,8X
   +          ,'VOLUMETRIC FLOWRATE',3X,F6.1,1X,'cfm',2X,'(MIN.)',/,8X
   +          ,'OPERATE AT',12X,F8.1,2X,'rpm',/,8X,'BRAKE HORSE POWER',
   +          2X,F6.3,3X,'hp')
      RETURN
      END


      SUBROUTINE ESTABLSH(D,W,A,TEMP,Q,RPM,P_RISE)
C ===============================================================
C |                                                             |
C |     THIS SUBROUTINE WILL BE USED TO CALCULATE DATA POINT    |
C |     ON A FAN CURVE.                                         |
C |                                                             |
C ===============================================================
C.....ASSIGN VARIABLES
C     EB  = DEFINED AS (Q*RPM/W)
C     EO  = DEFINED AS (3.1428*D*RPM)^2/g
C     RPM = FAN ROTATIONAL SPEED
C     EK  = KINETIC ENERGY GAIN PER UNIT MASS FO GAS
C     BETA = MEAN ANGLE AT WHICH GAS EXITS FROM FAN WHEEL
C     WSI = SHAFT INPUT POWER
C     EFF = TOTAL MECHAICAL EFFICIENCY OF FAN
C     ET  = TOTAL ENERGY GAIN PER UNIT MASS OF GAS
C     BHP = BRAKE HORSE POWER
C     P_RISE = PRESSURE STATIC PRESSURE GAIN

      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      V = 1/RHO(TEMP)
      EO = (D*RPM)**2/1698726.
      EB = (Q*RPM/W)/9650.
      EK = (Q/A)**2/231624.
C.....ASSUME AN INITIAL GM ,SAY GMA
s     GMA = 0.05178
      gma = 0.04
      DO 100 I=1,800
          GMAOLD = GMA
          BETA = ANGLE(GMA)
          WSI = EO-EB/TAN(BETA)
          EFF = EFFT(GMA)
          ET = WSI*EFF
          GMA = EK/ET
          ERR = ABS((GMA-GMAOLD)/GMAOLD*100)
          IF (ERR.LT.0.5) GOTO 200
 100      CONTINUE
 200   CONTINUE
        P_RISE = (ET-EK)/(5.204*V)
       BHP = WSI*Q/33000/V

       RETURN
       END
```

```
      SUBROUTINE VSD(D,W,A,TEMP,Q,P_RISE,RPM,PS,PSMAX)
C     ==========================================================
C     |                                                        |
C     |  THIS SUBROUTINE WILL CALCULATE FAN ELECTRICAL POWER WHEN |
C     |  USE VARIABLE SPEED DRIVE IS FLOW MODULATOR.           |
C     |                                                        |
C     ==========================================================
C
C.....ASSIGN VARIABLES
C        DUMMY =  A VARIABLE THAT USED TO INDICE THE FIRST CALCULATION
C              FOR FINDING PSMAX VALUE

      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      COMMON ICOUNT
      REAL N,NT
      DUMMY = 0.
      V = 1/RHO(TEMP)
      IF (ICOUNT.EQ.1) THEN
         DPG = PMAX
         Q = QMAX
         DUMMY = 1.
         GOTO 100
       END IF

  200 CONTINUE

       DPG = P_RISE
  100 EP = 5.204*V*DPG
       EK = (Q/A)**2/231624
       ET = EP+EK
       GM = EK/ET
       NT = EFFT(GM)
       BETA = ANGLE(GM)
       WSI = ET/NT

       C1 = D**2/1689726
       C2 = Q/(9650*W*TAN(BETA))
       N = (C2+SQRT(C2**2+4*C1*WSI))/(2*C1)

       DUMMY = DUMMY-1.
      IF (DUMMY.EQ.0.) THEN
         PSMAX = (Q*WSI/(33000.*V))*745.
         RPM = N
        GOTO 200
      END IF

      IF (Q.EQ.0.) THEN
         PS=0
         GOTO 300
       ELSE

C.....LET PS AS FAN SHAFT INPUT POWER,watt
       PS = (Q*WSI/(33000.*V))
       END IF
  300 RETURN
       END


      FUNCTION CORRECT(Particle,Temp,G,a,b,Dc,Vi,dpm)
C.....CALCULATE CORRECTION FOR EFFICIENCY
      REAL nn
      RELAX = PARTICLE*(dpm**2.)/(18*VISCOUS(TEMP))
      nn  = 1 - (1-0.668*(Dc**.14))*((TEMP+273)/293)**0.3
      EFF = 1 - EXP(-2*(G*RELAX*a*b*Vi*(Dc**2.)*(nn+1)
     +                 /Dc**3.)**(0.5/(nn+1)))
      CORRECT = EFF
      RETURN
      END


      FUNCTION FDP(DP)
C.....FUNCTION FOR CALCULATING MASS FRACTION AT PARTICLE SIZE
C.....FORM INPUT FILE (FOR ESTIMATE STANDARD AEROSOL)
      COMMON /ESTI/ C(9)
      FDP = EXP( C(1) + C(2)*LOG(DP) + C(3)*(LOG(DP))**2. )
      RETURN
      END
```

```
      FUNCTION QV(Q_TOTAL,NUMBER)
      REAL NUMBER
      QV = Q_TOTAL / NUMBER
      RETURN
      END

      FUNCTION VEL(Qi,Dc,a,b)
      VEL = Qi / (a*b*(Dc**2.))
      RETURN
      END

      FUNCTION V(PRESS_D,FLUID_DEN,a,b,De)
      V = ( PRESS_D/(8.19E-03*FLUID_DEN*(a*b/De**2.)) )**0.5
      V = V/10000
      RETURN
      END

      FUNCTION Q_(a,b,Vi,Dc)
      Q_ = a*b*Vi*(DC**2.)
      RETURN
      END

      FUNCTION VISCOUS(TEMP)
C.....COVERT CELSIUS TO KELVIN
C.....SI UNIT -> N*s/m^2
      T = 273.17 + TEMP
      A1 = +1.5394E-06
      A2 = +6.5222E-08
      A3 = -3.59062E-11
      A4 = +1.36813E-14
      A5 = -1.83018E-18
      VISCOUS = A1+A2*(T)+A3*(T**2.)+A4*(T**3.)+A5*(T**4.)
      RETURN
      END

      FUNCTION ANGLE(GM1)
C.....FUNCTION FOR CALCULATING MEAN ANGLE AT WHICH GAS EXITS FROM
C.....FAN WHEEL
      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      BETA = EXP(ABE(1)+ABE(2)*LOG(GM1)+ABE(3)*(LOG(GM1))**2)
      ANGLE = BETA*(22./7.)/180.
      RETURN
      END

      FUNCTION EFFT(GM1)
C.....FUNCTION FOR CALCULATING TOTAL MECHANICAL EFFICIENCY OF FAN
      COMMON /PROP/ ABE(9),ANT(9),PMAX,QMAX
      EFFT = EXP(ANT(1)+ANT(2)*LOG(GM1)+ANT(3)*(LOG(GM1))**2)
      RETURN
      END

      FUNCTION RHO(TEMP)
C.....DENSITY OF AIR AT STANDARD TEMPERATURE AND PRESSURE
C.....COVERT UNIT SI.(g/cm^3) -> UNIT ENG.(lb/ft^3)
      RHO = (29./22400)*(293/(273+TEMP))*(1000/16.019)
      RETURN
      END
```

ภาคผนวก ข.

Input File สำหรับโปรแกรม

Input File สำหรับการคำนวณของโปรแกรมคอมพิวเตอร์

```
<
  CYCLONE & FAN PERFORMANCE CURVE DATA FILE

  Consist of
  Part I  : Cyclone data
  Part II : Fan data

  Input by  :  Panotson  Sujayanont
  Date      :  1 February 1999
  Comment   :  This input file is used as an example in thesis,
               name A Computer Program for Cyclone Design
>
< Part I  : Cyclone data
  Input Mode of computation (1,2,3)
     Choose 1 : for application case
     Choose 2 : for user defines
     Choose 3 : for cyclone design (by inlet conditions)

  Input application case
     Choose 1 : for input [Number of cyclones,Cyclone diameter]
     Choose 2 : for input [Number of cyclones,Press drop]
     Choose 3 : for input [Cyclone diameter,Pressure drop]
     Choose 4 : for input [Number of cyclones,Overall efficiency]
     Choose 5 : for input [Cyclone diameter,Overall efficiency]
     Choose 6 : for input [Overall efficiency,Pressure drop]
     (for MODE = 1)

  Input geometry cyclone
     Consist of : Dc, a, b, De, S, h, H, B
     (for MODE = 2)

  note : Dc = Cyclone dia,m.     S = Outlet length,m
          a = Inlet height,m.    h = Cylinder height,m
          b = inlet width,m.     H = Overall height,m
         De = Outlet dia,m.      B = Dust outlet dia,m

  Input type of cyclone
     Choose 0 : when MODE = 2
     Choose 1 : for high efficiency, medium throughput
     Choose 2 : for medium efficiency, high throughput
                Stairmand design
      (for MODE = 1 and MODE = 3)
>
  3
  1
<
  Enter data for inlet condition
  Consist of :
  (a) Particle size distribution
     Number of  data

    [Mass fraction]
    MF(1)  MF(2)  MF(3)  MF(4)  MF(5)  MF(6)
    MF(7)  MF(8)  MF(9)   ...    ...   MF(i)

   [Range]
   DP_(1)  DP_(2)  DP_(3)  DP_(4)  DP_(5)  DP_(6)
   DP_(7)  DP_(8)  DP_(9)   ...     ...    DP_(i)

  (b) Volumetric flowrate, m^3/sec
  (c) Particle density, g/cm^3
  (d) Temperature, Celsius
  (e) Dust rate, g/s (Enter zero, when don't know value)
  (f) Standard air pollution, g/m^3
```

```
>
11
6.    2.   6.   7.   12.  9.
14.   10.  12.  14.  8.   0.
104.  75.  60.  40.  30.  20.
15.   10.  7.5  5.   2.5  0.
6.28
1.5
121.1
12
0.40
<
```

Fan Characteristic Curve :
(for centrifugal-fan)

Input MODE of Fan Performance Curve
Choose 1 : Default fan curve
Choose 2 : User input datas for generate fan curve

NOTE :
Case MODE = 1
Typical data sets for series of fans used in program.
Data from YORK, BI DWDI

D	W	A	N	Q	DP	P
18.25	3.65	3.45	801	4000	0.50	0.59
18.25	3.65	3.45	1349	7600	1.00	2.91
18.25	3.65	3.45	1689	8800	2.00	5.58
16.50	3.30	2.82	995	3600	0.375	0.58
16.50	3.30	2.82	1349	4800	0.75	1.45
16.50	3.30	2.82	1602	3800	2.50	2.47
15.00	3.00	2.33	833	2200	0.25	0.20
15.00	3.00	2.33	1411	3100	1.25	1.06
15.00	3.00	2.33	1881	3000	3.00	2.41
13.50	2.70	1.89	1093	1900	0.50	0.29
13.50	2.70	1.89	1583	2800	1.00	0.86
13.50	2.70	1.89	1989	2700	2.50	1.75
12.25	2.45	1.55	1238	1500	0.625	0.26
12.25	2.45	1.55	1375	2200	0.25	0.34
12.25	2.45	1.55	1697	2600	0.50	0.64
12.25	2.45	1.55	1871	2400	1.25	0.88
12.25	2.45	1.55	1964	2000	2.00	1.04
12.25	2.45	1.55	2265	3400	1.00	1.54

Case MODE = 2
Format input data sets for series of fans.

```
D1   W1   A1   N1   Q1   DP1   P1
D2   W2   A2   N2   Q2   DP2   P2
.    .    .    .    .    .     .
.    .    .    .    .    .     .
.    .    .    .    .    .     .
Dn   Wn   An   Nn   Qn   DPn   Pn
```

(n = number of data points)

Format input data sets for sizing.

```
D1   W1   A1   QMIN1
D2   W2   A2   QMIN2
.    .    .    .
.    .    .    .
.    .    .    .
Dm   Wm   Am   QMINm
```

(m = number of selected size)
: at least 4 data points :

Nomenclature : D = Fan wheel dia,in. Q = Volumetric flowrate,cfm
W = Fan tip width,in. Dp = Static pressure gain,in.WG
A = Discharge area,ft^2 P = Shaft input power,hp
N = Fan rotational speed,rpm
(Unit English)

Select MODE (1 or 2).

Enter number of data points.
(Case MODE = 2 Default by user)

Enter fan data points for establishing a centrifugal-fan performance curve.
(Case MODE = 2 Default by user)

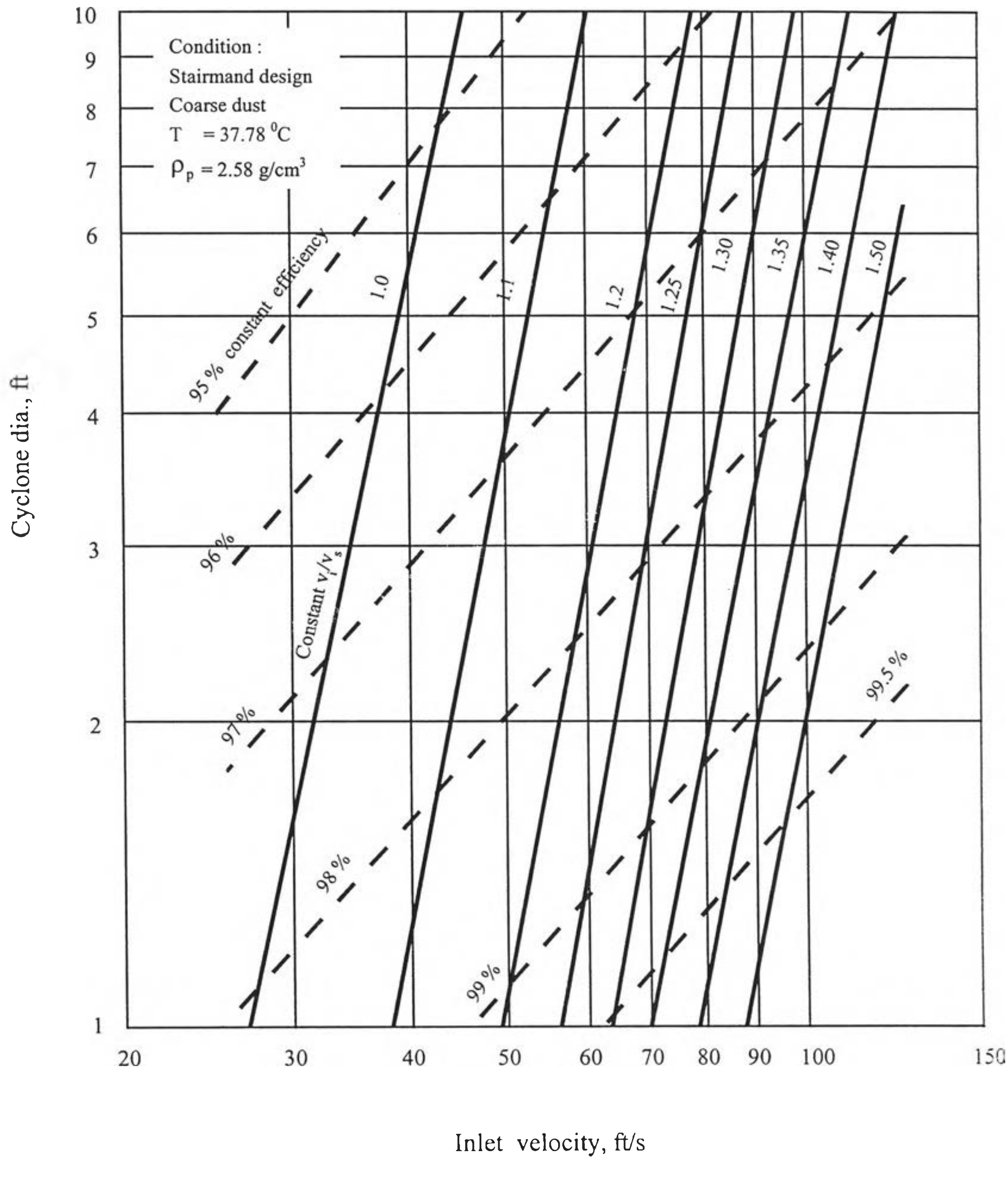
Enter number of user's fan size.
(Case MODE = 2 Default by user)

Enter user's fan size.
(Case MODE = 2 Default by user)

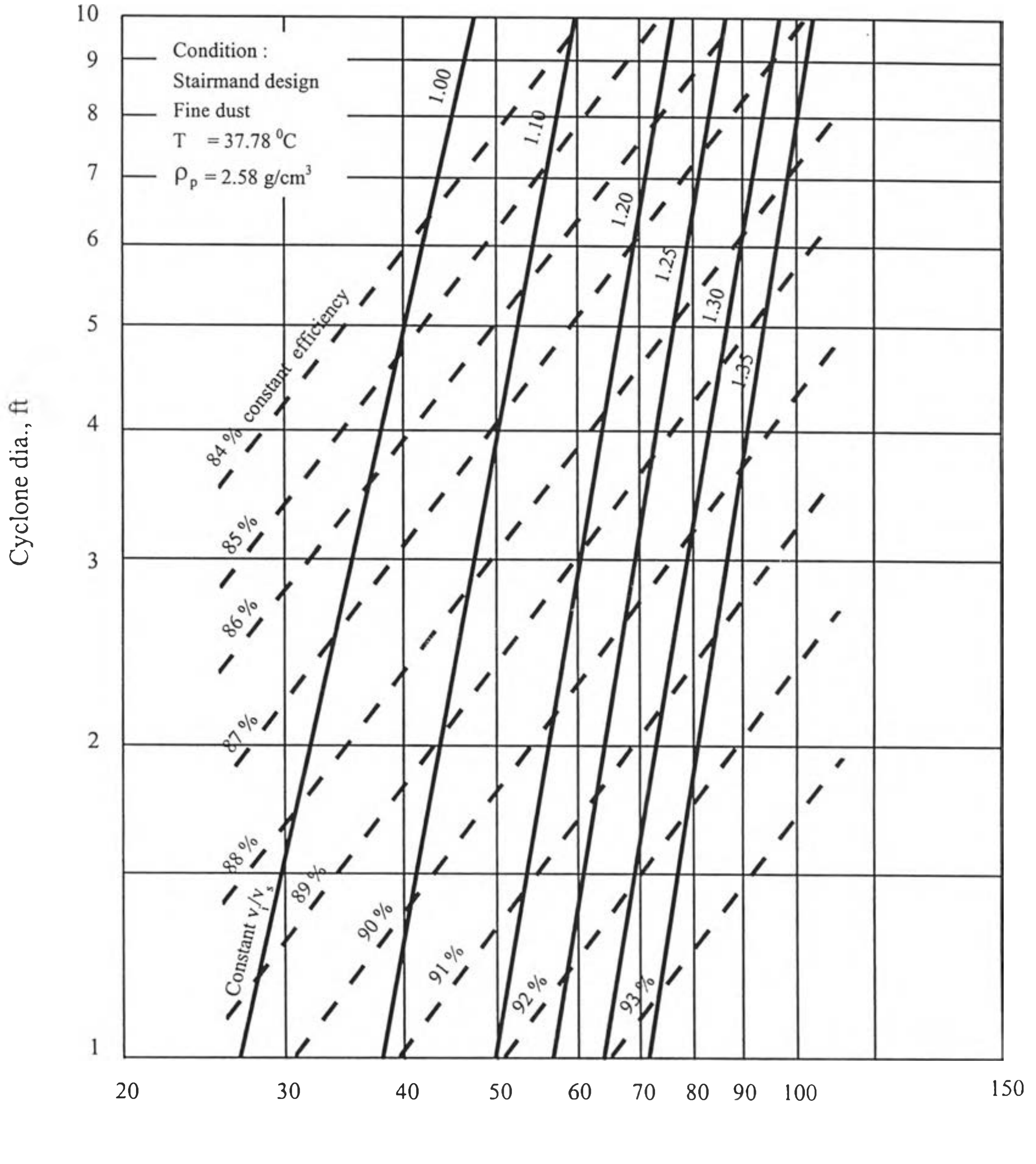
```
>
2
33
18.25   3.65   3.45   1394    6000   2.00    2.99
18.25   3.65   3.45   1729   10400   1.25    6.19
18.25   3.65   3.45   1998    8000   4.50    8.63
18.25   3.65   3.45   2028   10400   3.00    9.61
18.25   3.65   3.45   2362   12200   4.00   15.23
18.25   3.65   3.45   2241    9200   5.50   12.25
16.50   3.30   2.82   1197    4400   0.50    1.02
16.50   3.30   2.82   1349    4800   0.75    1.45
16.50   3.30   2.82   1827    6900   1.00    3.62
16.50   3.30   2.82   1881    6900   1.25    3.94
16.50   3.30   2.82   2207    8300   1.50    6.37
16.50   3.30   2.82   1607    3800   2.50    2.47
16.50   3.30   2.82   1886    4400   3.50    4.02
15.00   3.00   2.33    833    2200   0.25    0.20
15.00   3.00   2.33   1149    3000   0.50    0.56
15.00   3.00   2.33   1572    4300   0.75    1.43
15.00   3.00   2.33   1411    3100   1.25    1.06
15.00   3.00   2.33   1737    3700   2.00    1.98
15.00   3.00   2.33   1881    3000   3.00    2.41
13.50   2.70   1.89   1093    1900   0.50    0.29
13.50   2.70   1.89   1351    2500   0.625   0.54
13.50   2.70   1.89   1936    3800   1.00    1.58
13.50   2.70   1.89   2546    5300   1.25    3.59
13.50   2.70   1.89   2185    3800   2.00    2.29
13.50   2.70   1.89   2632    4800   2.50    4.00
13.50   2.70   1.89   2267    2700   0.625   2.52
12.25   2.45   1.55   1407    2000   0.50    0.36
12.25   2.45   1.55   2265    3400   1.00    1.54
12.25   2.45   1.55   2726    4200   1.25    2.70
12.25   2.45   1.55   2598    3800   1.50    2.34
12.25   2.45   1.55   1700    2400   0.75    0.65
12.25   2.45   1.55   2281    2500   2.50    1.63
12.25   2.45   1.55   2534    2400   3.50    2.20
5
18.25   3.65   3.45   2800
16.50   3.30   2.82   2200
15.00   3.00   2.33   1900
13.50   2.70   1.89   1500
12.25   2.45   1.55   1200
```

ภาคผนวก ค.

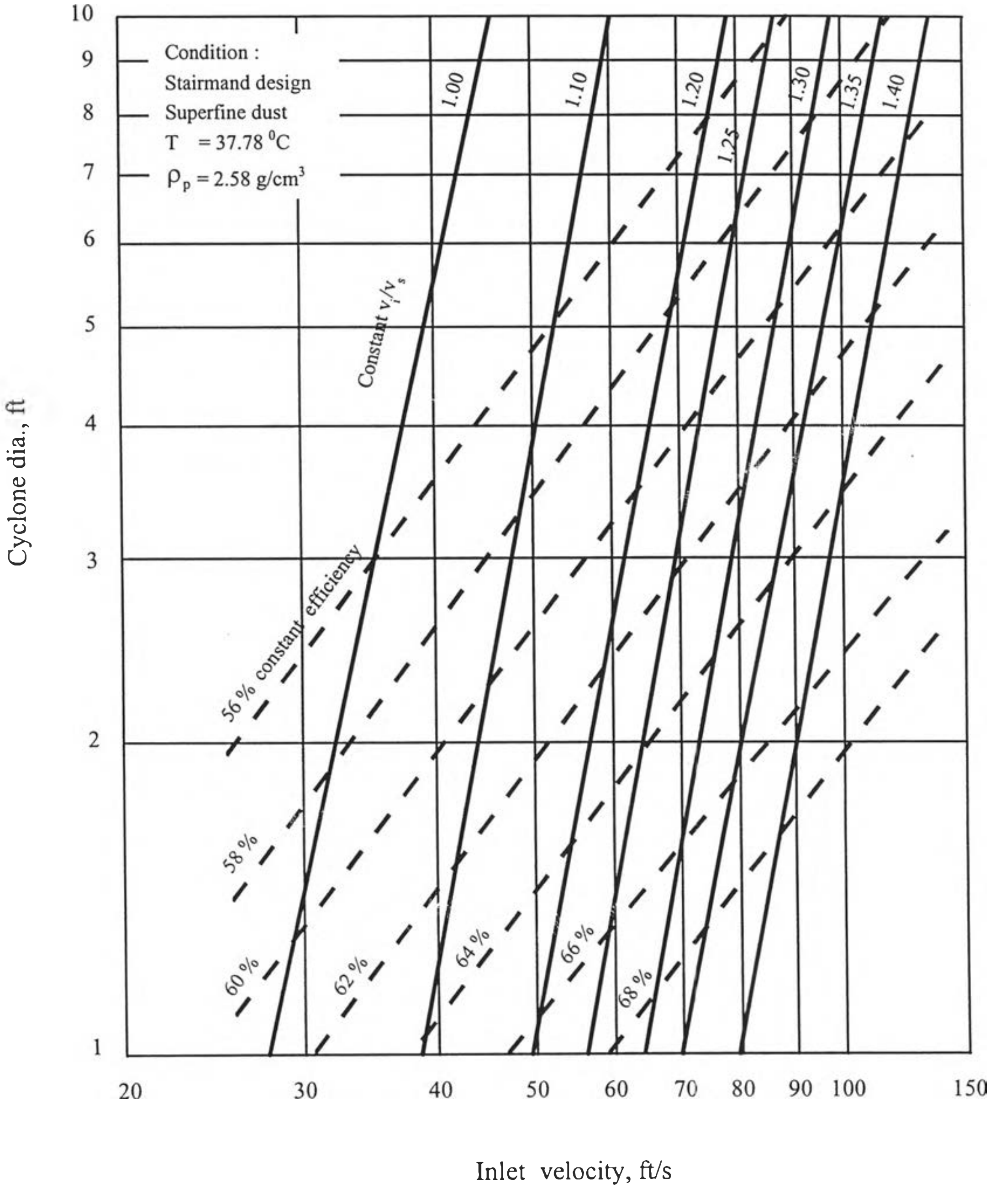
การเลือกออกแบบไซโคลนตามประเภทของฝุ่น



ค.1 กราฟแสดงการเลือกออกแบบไซโคลนของ Stairmand สำหรับประเภทฝุ่นหยาบ



ค.2 กราฟแสดงการเลือกออกแบบไซโคลนของ Stairmand สำหรับประเภทฝุ่นละเอียด



ค.2 กราฟแสดงการเลือกออกแบบไซโคลนของ Stairmand สำหรับประเภทฝุ่นละเอียดมาก

ภาคผนวก ง.

มาตรฐานคุณภาพอากาศ

มาตรฐานการแพร่กระจาย (Emission Standards)

ตาราง ง.1 มาตาราฐานการแพร่กระจายของโรงงานอุตสาหกรรม (Industial Emission Standards)

No.	Substances	Sources	Standard Values
1.	Particulate	Boiler	
		- Heavy oil as fuel	300 mg / m^3
		- Coal as fuel	400 mg / m^3
		- Other fuel	400 mg / m^3
		Steel / Aluminium manufacturing	300 mg / m^3
		Other source	400 mg / m^3
2.	Antimony	Any Source	20 mg / m^3
3.	Arsenic	Any Source	20 mg / m^3
4.	Copper	Any Source	30 mg / m^3
5.	Lead	Any Source	30 mg / m^3
6.	Chlorine	Any Source	30 mg / m^3
7.	Hydrogen chloride	Any Source	200 mg / m^3
8.	Mercury	Any Source	3 mg / m^3
9.	Carbon	Any Source	1,000 mg / m^3 or 870 ppm
10.	Sulfur dioxide	Any Source	100 mg / m^3 or 25 ppm
11.	Hydrogen sulphide	Any Source	140 mg / m^3 or 100 ppm
12.	Sulfur dioxide	H_2SO_4 production	1,300 mg / m^3 or 500 ppm
13.	Oxides of nitrogen	Boiler	
	(as Nitrogen dioxide)	- Coal as fuel	940 mg / m^3 or 500 ppm
		- Other fuel	470 mg / m^3 or 250 ppm
14.	Xylene	Any Source	870 mg / m^3 or 200 ppm
15.	Cresol	Any Source	22 mg / m^3 or 5 ppm
16.	Sulfur dioxide	Heavy oil as fuel	1,250 ppm

Source : 1-14 : Notification of the Ministry of Industry No.2, B.E. 2536(1993), issued under Factory Act B.E. 2535(1992), dated July 20, B.E. 2536(1993), publish in the Royal Government Gazettle. Vol.109, Part 108, dated October 16, B.E. 2536

15 : Notification of the Ministry of Industry No.9, B.E. 2538(1995), issued under Factory Act B.E. 2535(1992), dated September 6, B.E. 2538(1995)

16 : Notification of the Ministry of Industry No.3, 2538(1996) for Factory in Bangkok and Sumut Prakran, dated September 3, B.E. 2539(1996)

ตาราง ง.2 มาตรฐานการแพร่กระจายสำหรับโรงงานไฟฟ้าใหม่ (Emission Standard for New Power Plants)

No.	Pollutants	Type of Fuel		
		Coal	Oil	Gas
1.	Sulfur dioxide (SO_2) (ppm)			
	Power Plants Size > 500 MW	320	320	20
	300-500 MW	450	450	20
	< 300 MW	640	640	20
2.	Oxides of nitrogen (as NO_2) (ppm)	350	180	120
3.	Particulate (mg/m^3)	120	120	60

Remark : Reference Condition are 25 degree Celsius at 1 atm or 760 mm.Hg. excess air at 50% or excess O_2 at 7%

ตาราง ง.3 มาตรฐานการแพร่กระจายสำหรับโรงงานไฟฟ้าที่มีอยู่ (Emission in Standards for Existing Power Plants)

No.	Pollutants	Type of Fuel		
		Coal	Oil	Gas
1.	Sulfur dioxide (SO_2) (ppm)	1,000	1,000	1,000
2.	Oxides of nitrogen (as NO_2) (ppm)	400	200	200
3.	Particulate (mg/m^3)	320	240	60

Remark : Reference Condition are 25 degree Celsius at 1 atm or 760 mm.Hg. excess air at 50% or excess O_2 at 7%

มาตรฐานการแพร่กระจายสำหรับโรงงานไฟฟ้าที่มีเชื้อเพลิงปนกัน (Emission Standards for Power Plant with Mixed Fuel)

ในกรณีที่โรงงานไฟฟ้ามีชนิดของเชื้อเพลิงปนกันที่แต่ละส่วน ค่ามาตรฐานนี้จะขึ้นอยู่กับการคำนวณของอัตราส่วนของเชื้อเพลิง สามารถคำนวณได้จาก

มาตรฐานการแพร่กระจาย (Emission Standard) = AX + BY + CZ

เมื่อ

A = Emission Standard for utilizing only coal as fuel.

B = Emission Standard for utilizing only oil as fuel.

C = Emission Standard for utilizing only gas as fuel.

X = Ratio of Heat Input from utilizing only coal as fuel.

Y = Ratio of Heat Input from utilizing only oil as fuel.

Z = Ratio of Heat Input from utilizing only gas as fuel.

ตาราง ง.4 มาตรฐานการแพร่กระจายสำหรับโรงงานโม่หิน (Emission Standard of Crushed-Stone Plant)

No.	Pollutants	Standard	Unit	Measurement Methods
1..	Particulates (Without capture / collection system)	20	Percent	Smoke Opacity Meter (at the distance 1 meter around the source)
2.	Particulates (Without capture / collection system)	400 20	mg/cu.m. Percent	US.EPA. Method 5 Smoke Opacity Meter (at the emission stack)

ตาราง ง.5 มาตรฐานการแพร่กระจายสำหรับเตาเผาขยะมูลฝอย (Emission Standard for Municipal Waste Incinerators)

NO.	Pollutants	Capacity of Incinerator		Measurement Methods
		More than 50 tons/day	More than 50 tons/day	
1.	TSP (mg/m^3)	120	400	U.S.EPA Method 5 or equivalent method
2.	SO_2 (ppm)	30	30	U.S.EPA Method 6,8 or equivalent method
3.	NO_X as NO_2 (ppm)	180	250	U.S.EPA Method 7 or equivalent method
4.	Opactiy (%)	10	20	U.S.EPA Method 9 or equivalent method
5.	HCl (ppm)	25	136	U.S.EPA Method 26 or equivalent method
6.	Dioxin[2*] (ng/m^3)[3*]	30	30	U.S.EPA Method 23 or equivalent method

Source : Notification of Ministry of Science, Technology and environmental , dated June 17 B.E. 2540(1997)

Remark : 1* The concentrations of air emissions are based on the reference conditions at 25 ^{0}C, preesure of 760 mm.Hg. or 1 atmosphere, and excess oxygen content of 7 % or excess air content of 50% (basis)

2* Dioxin means total chlorinated PCDD plus PCDF

3* 1 ng (nanogram) is equivalent to 10^{-6} mg

4* Equivalent methods to be approved by Pollution Control Department

มาตรฐานคุณภาพอากาศ (Ambient Air Quality Standard)

ตาราง ง.6 มาตรฐานคุณภาพอากาศ (Ambient Air Quality Standard)

Pollutants	1-hr . average value		1-hr . average value		1-hr . average value		1-hr . average value		1-hr . average value		Measurement Methods
	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	
Carbon monoxide	34.2	30	10.26	9	-	-	-	-	-	-	Non-Dispersive infrared detection
Nitrogen dioxide	0.32	0.17	-	-	-	-	-	-	-	-	Chemiluminescence
Sulfur dioxide	0.78	0.30	-	-	0.30	0.12	-	-	0.10*	0.04	Pararosaniline
Suspended Particulate Matter (SPM)	-	-	-	-	0.33	-	-	-	0.10*	-	Gravimetric-High Volume
Particulate matter < 10 μm	-	-	-	-	0.12	-	-	-	0.05*	-	Gravimetric-High Volume
Photochemical Oxidant	0.20	0.10	-	-	-	-	-	-	-	-	Chemiluminescence
Lead	-	-	-	-	-	-	1.5*	-	-	-	Atomic Absorption Spectrometer

Remark : 1) * : Geometric mean value

2) Concentration of each gas in ambient is based on 1 atm. And 25 ^{0}C

Source : Notification of the Nation Environment Board. No.10, B.E. 2538(1995), date April 17, B.E. 2538(1995)

ภาคผนวก จ.

ตารางแสดงค่าความหนาแน่นของอนุภาค

ตาราง จ.1 แสดงความหนาแน่นของอนุภาค[16]

Material	Density (g/cm^3)
Alum, Lumpy	0.8 - 0.96
Alum, Pulverized	0.72 - 0.80
Alumina	0.96
Aluminum Hydrate	0.29
Aluminum Oxide	1.20 - 1.36
Asbestos, Shred	0.32 - 0.40
Bagasse	0.112 - 0.128
Bakelite, Powder	0.48 - 0.64
Bauxite, Crushed	1.20 - 1.36
Bonemeal	0.88 - 0.96
Borox, Powder	0.85
Cement, Portland	1.20 - 1.36
Cement, Clinker	0.64
Coal, Anthracite, Granular	0.96
Coal, Bituminous, Minus ½"	0.80
Cocoa, Powder	0.48 - 0.56
Cocoa, Beans	0.48 - 0.64
Coffee, Green Bean	0.513
Coffee, Ground	0.40
Coffee, Roasted Bean	0.35 - 0.42
Coke, Loose	0.37 - 0.42
Copper, Ore	1.92 - 2.40
Cork, Fine Ground	0.19 - 0.24
Corn, Cracked	0.72 - 0.80
Cullet	1.28 - 1.92
Dolomite, Crushed	1.44 - 1.60
Fly ash	0.56 - 0.64

ตาราง จ.1 แสดงความหนาแน่นของอนุภาค (ต่อ)

Material	Density (g/cm^3)
Graphite, Flour	0.45
Gypsum, Calcined	0.85 - 0.96
Ice, Crushed	0.56 - 0.72
Lime, Hydrated	0.64
Lime, Pebble	0.90
Limestone, Crushed	1.36 - 1.44
Oats	0.42
Peanuts, Shelled	0.32 - 0.40
Phosphate Rock	1.20 - 1.36
Rice, Hulled	0.72
Salt, Fine	1.12 - 1.28
Sand, Dry	1.44 - 1.60
Soap Powder	0.32 - 0.40
Soda Ash, Light	0.32 - 0.56
Soda Ash, Heavy	0.88 - 1.04
Sodium Sulfate	0.72
Stone, Crushed	1.36 - 1.44
Sugar, Granulated	0.80 - 0.88
Wheat	0.72 - 0.77

ภาคผนวก ฉ.

ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค[17]

Substance	Methods Suggested
Abrasives	SS, S
Acid pickling	S
Acid vapors	S
Acrylate polymerization	CF, DF
Air conditioning	S
Alfalfa dust	C, SC
Alumina	C, BC, S, E
Aluminum dust	C, BC, S
Aluminum inoculation	S
Aluminum ore reduction	S
Asbestos	BC
Asphalt blowing and saturating	BC, CF
Asphalt manufacturing	S
Asphalt plants	S
Asphalt saturators	EL
Atomic wastes	S
Automotive paint baking	CF
Bagasse	BC
Baking fat aerosol	E
Baking power	BC
Bark	C, S, E
Barley flour dust	C
Basic oxygen furnace	S, E
Batch spouts for grains	BC
Bauxite	C, BC, E
Blast furnace gas	S
Bonding and burnoff	CF
Broze powder	BC
Brunswick clay	BC
Buffing wheel operations	BC
Burnoff ovens	DF, CF
Calciners	S

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Carbon	BC
Carbon, black	C, BC, S, E
Carbon, calcines	BC*
Carbon, furnaces	CF, DF
Carbon, green	BC*
Carbon, banbury mixer	BC*
Carpet mill drying	E
Catalyst dust (Catalysis reger.)	C, E
Cement	C, BC, S, E
Cement, crushing	BC
Cement, finished	BC*
Cement, grinding	BC
Cement, kiln (wet process)	BC
Cement, milling	BC*
Ceramic frit	S
Ceramics	BC
Chaff, wheat	C
Charcoal	BC
Chemical fume control	S
Chemical processing	CF, DF
Chemical, pulp and paper	S
Chlorine tall gas	B
Chocolate	BC
Chrome (ferro crushing)	BC*
Chrome ore	BC
Classifiers	S
Clay	BC
Clay, green	BC*
Clay, vitrified silicious	BC*
Cleanser	BC
Coal	C, E
Coal drying	C

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Coal mill vents	C, BC
Coal mining	S
Coal processing	S
Cocoa	BC
Coffee roasting	CF, DF
Coil and strip coating	CF, DF
Coke	BC
Coke (fluid)	C, E
Coke oven gas	S
Coke oven quenching	S
Coke ovens	E
Conveying	BC, S
Copper converter	E
Copper reverb	E
Copper roaster	C, E
Cork	BC
Corn popping	CF
Cosmetics	BC
Cotton	BC
Crushers	S
Cupola	BC, S, E
Cupola, gas	S
Deep fat frying	CF
Detergent power	C
Dissolver tank vents (P and P)	C, S
Distillation and absorption	S
Driers	S
Dust cleaning	S
Dust, foundry tumbling	IC
Dust, grinding (machine shop)	IC
Dust, light	S
Electric furnace	BC, S*, E

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Electroplating	S
Electroplating towers	S
Element phos	E
Enamel (porcelain)	BC*
Explosive dusts	S
Fabric curing	CF, DF
Feeds and grain	C, BC
Feldspar	BC
Ferrite	S
Fertilizer	S
Fertilizer, bagging	BC
Fertilizer, cooler, dryer	BC
Fertilizer, manufacturing	S
Fertilizer, Phosphate	S
Fish and vegetable processing	CF
Fling	BC
Flour	C, BC, BC*
Flue gas	S
Fluid bed process	S
Fly ash	S, C
Food	S
Food processing	CF
Foundry	S
Foundry core baking	CF
Fungicide manufacture	CF
Glass	BC
Grain	BC*
Graphite	BC, BC*
Grinding and separating	BC
Grind wheel sintering	CF
Gypsum	C, BC, BC*, S, E
Hardboard coating and curing	CF

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Hot coating	S
Hot scarfing	S,E
Household ventilation	S
Ilmenite	C,E
Incinerators, apartment	S, DF
Incinerators, municipal	C, S, E
Iron foundry	S
Iron ore	BC
Iron oxide	BC
Iron scale and sand grinding	C
Kilns	S
Kilns, rotary	S
Kraft paper (P and P)	S,DF
Lampblack	BC
Lead furnace	BC,S
Lead oxide	BC
Lead oxide fume	BC*
Leather	BC
Lignite	C, E
Lime	C, E, S
Lime kiln	S
Limestone	BC*
Lumber mills	C
Maching operations	C, BC, S
Magnesium oxide	C
Manganese	BC
Marble	BC
Metal chip drying	CF
Metal decorating	CF, DF
Metallic dust	IC
Metallurgical fumes	BC*
Metal mining	S

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Mica	BC, BC*
Moisture separastors	S
Molybdenum	E
Nitric acid mists	S
Nut roasting	CF
Odor control	S
Oil aerosols	E
Oil hydrogenation	CF
Oil mists	S
Oil quenching	CF
Oil sulfurization	CF, DF
Open hearth furnace	S,E
Ore benification	C, BC, S, E
Ore mining	S
Ore roasters	S, E
Oxygen steel making	S
Packing machines	S
Paint and varnish cooking	CF, DF
Paint pigments	BC, BC*, S
Paper	BC
Paper coating	CF
Pharmaceuticals	S, CF
Phenol-formaldehyde resin	E
Phenolic molding powers	BC*
Phosphate	C, BC, S, E
Phoshoric acid	S
Phoshoric acid mists	CF
Phthalic anhydride mfg.	S
Pigment mfg.	BC
Plastics	S
Plating	BC*
Polyvinyl choride (PVC)	CF, DF

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Potato chip cooking	BC, E
Precious metal	S
Precooler, blast furnace gas	CF, DF
Printing	C
Pulp dus, orange, feed dryer	C
Pyrites roaster	C, S, E
Quartz	BC
Radioactive and toxic dusts	S
Refinery catalyst	C, E
Refractory bricksizing (after fire)	BC*
Rice browning	CF
Roasting	S
Rock	BC
Rubber, curing	E
Sand and gravel dust, asphalt mixing	C
Sand blasting	BC*
Sand machines	BC
Sand and stone dust	C, S
Sewage treatment	DF
Silica dust, sand drying kiln	C, IC, BC
Silica dust, stone drying kiln	C
Silicon carbide	C, BC*
Sintering	S, E
Smoke	S
Smoke abatement	DF
Smoke control	S
Smoke houses	DF
Smoke, wood	E
Soap and detergent	BC, BC*
Soapstone	BC
Soda (P and P)	S, E
Soy bean	BC*

ตารางที่ ฉ.1 ชนิดของอนุภาคกับอุปกรณ์ดักเก็บอนุภาค (ต่อ)

Substance	Methods Suggested
Spray drying	C, BC, S
Starch	BC, BC*
Stationary diesel engine	CF
Sugar	BC, BC*
Sulfuric acid	S, E
Sulfuric acid mists	S
Synthetic rubber mfg.	CF, DF
Taconite	C. E
Talc dust	C, BC, BC*
Tantalum fluoride	BC*
Tar coating	CF
Textile finishing	DF
Titanium dioxide	BC, S, E
Tobacco	E
Vaporized fats	E, CF, DF
Vitamin manufacture	CF
Wax burning, investment casting	CF
Wire enameling	CF, DF
Wood	C, BC, S, E
Wood dust	C
Wood flour	BC*
Wood sawing	BC*
Zinc, metallic	BC*
Zinc roaster	C, E
Zinc smelter	E
Zinc stearite, fluffy, surface coat	C

Methods suggested have been used by industry. The table is intended as a starting point. Meaning of symbols are as follows :

C = Cyclone

IC = Impeller collector mechanical type

SC = Settling chamber

BC = Baghouse (fabric cleaner)

E = Eletrostatic precipitator

CF = Catalytic combustion

Df = Direct flame combustion

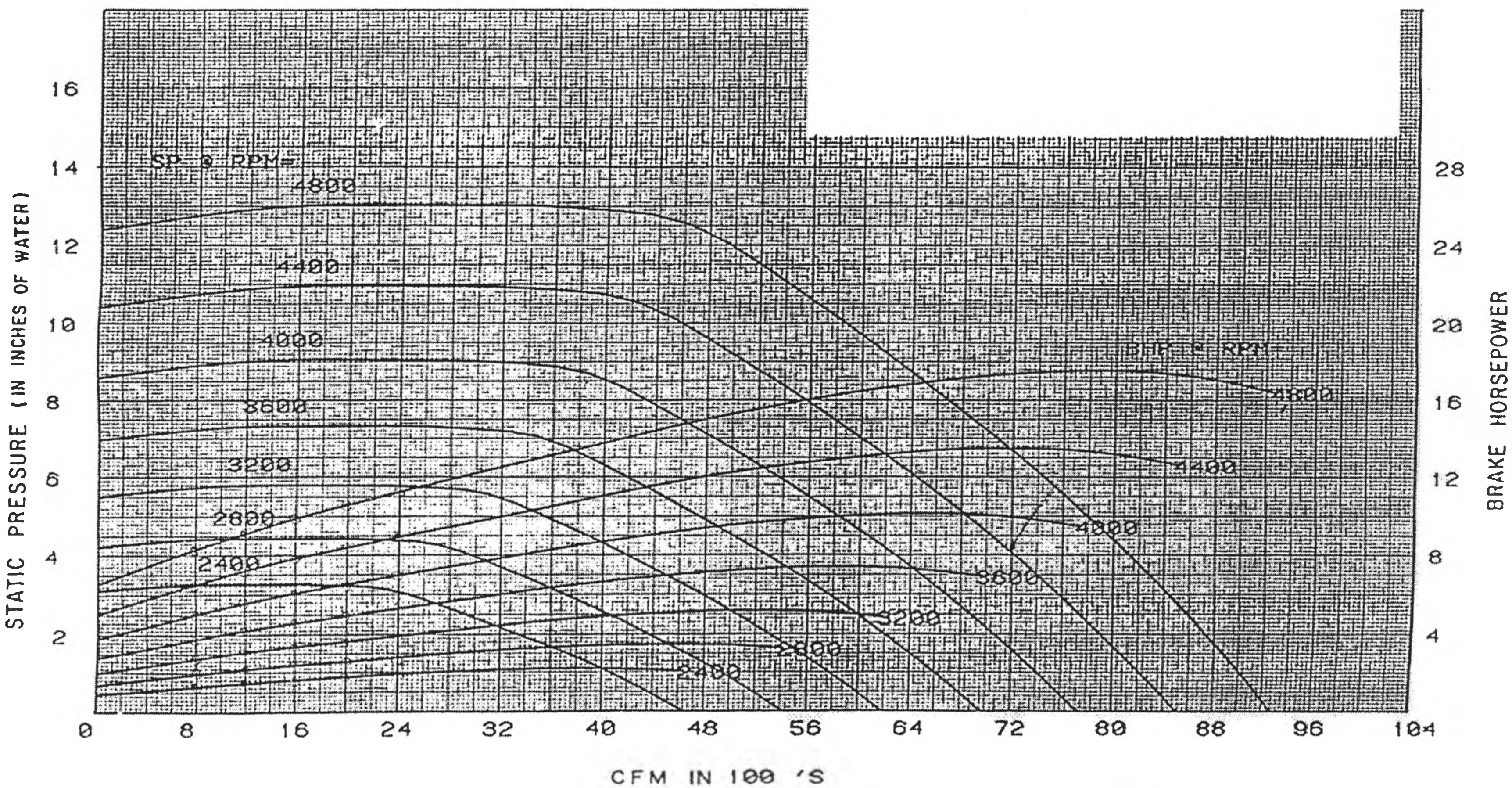
S = Scrubber

* = Special configuration of designated process may be necessary or more desirable

ภาคผนวก ฌ.

ชุดข้อมูลพัดลม YORK (BI DWDI)

12-1/4" BI DWDI



กราฟ ฌ.1 กราฟแสดงสมรรถนะของพัดลม YORK (BI DWDI) ขนาด 12.25″

ตาราง ฌ.1 ชุดข้อมูลพัดลม YORK (BI DWDI) ขนาด 12.25″

FORM 100.02-EG1 (SUPL 1)

12-1/4″ BI DWDI

INLET AREA = 1.840 SQ. FT. • WHEEL DIAMETER 12-1/4″
DISCHARGE AREA = 1.55 SQ. FT. • TIP SPEED F.P.M. = 3.21 x R.P.M. • MAXIMUM B.H.P. = $.1418 \left(\frac{R.P.M.}{1000}\right)^3$

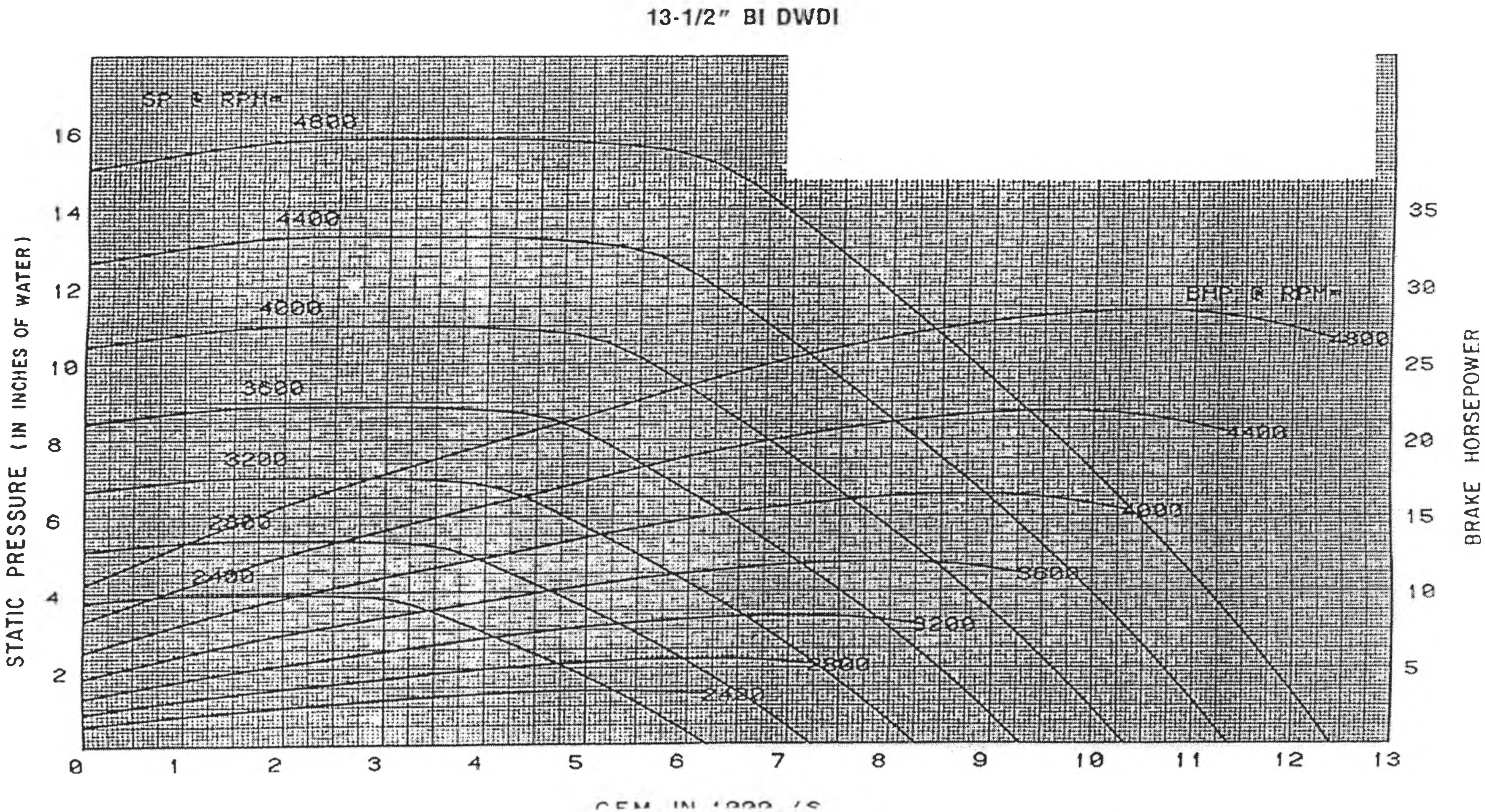
Top white area is Class I. Top gray area is Class II.

CFM	OV	1/4" SP		3/8" SP		1/2" SP		5/8" SP		3/4" SP		7/8" SP		1" SP		1-1/4" SP		1-1/2" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1200	774	894	0.10	975	0.13	1050	0.16	1124	0.20	1196	0.22	1267	0.28	1337	0.32	1475	0.40	1607	0.52
1300	839	941	0.11	1018	0.14	1090	0.17	1159	0.20	1226	0.25	1293	0.30	1359	0.34	1486	0.44	1614	0.54
1400	903	988	0.13	1063	0.16	1132	0.20	1197	0.24	1260	0.28	1323	0.32	1385	0.35	1507	0.45	1627	0.56
1500	968	1036	0.15	1109	0.17	1175	0.22	1238	0.26	1298	0.30	1357	0.34	1415	0.39	1530	0.48	1644	0.60
1600	1032	1084	0.17	1156	0.20	1220	0.25	1280	0.29	1338	0.32	1394	0.36	1450	0.41	1558	0.52	1666	0.63
1700	1097	1132	0.19	1203	0.22	1266	0.27	1324	0.32	1380	0.35	1434	0.40	1486	0.44	1590	0.55	1692	0.65
1800	1161	1181	0.22	1251	0.26	1313	0.30	1369	0.34	1423	0.39	1475	0.44	1526	0.48	1625	0.59	1722	0.69
1900	1226	1230	0.25	1299	0.29	1360	0.34	1415	0.38	1468	0.43	1518	0.48	1567	0.53	1662	0.63	1754	0.73
2000	1290	1278	0.28	1347	0.32	1407	0.36	1462	0.41	1513	0.46	1562	0.52	1609	0.56	1701	0.68	1790	0.79
2100	1355	1327	0.30	1396	0.35	1455	0.40	1509	0.45	1559	0.51	1607	0.56	1653	0.61	1741	0.71	1827	0.83
2200	1419	1375	0.34	1444	0.40	1503	0.44	1556	0.51	1605	0.56	1652	0.60	1697	0.65	1784	0.78	1867	0.88
2300	1484	1424	0.39	1493	0.44	1551	0.50	1604	0.55	1652	0.60	1698	0.65	1743	0.71	1827	0.83	1908	0.94
2400	1548	1473	0.43	1541	0.48	1600	0.55	1652	0.60	1700	0.65	1745	0.71	1788	0.77	1871	0.88	1950	1.01
2500	1613	1522	0.48	1590	0.54	1648	0.60	1700	0.65	1748	0.70	1792	0.77	1835	0.83	1916	0.94	1993	1.08
2600	1677	1570	0.53	1639	0.59	1697	0.64	1748	0.70	1795	0.77	1840	0.83	1882	0.89	1961	1.02	2037	1.14
3000	1935	1766	0.75	1833	0.83	1891	0.91	1942	0.97	1988	1.04	2032	1.12	2072	1.18	2148	1.33	2219	1.46
3400	2194	1963	1.04	2028	1.13	2086	1.22	2137	1.31	2183	1.38	2225	1.46	2265	1.54	2339	1.70	2407	1.87
3800	2452	2161	1.39	2224	1.51	2281	1.61	2331	1.70	2377	1.81	2420	1.89	2459	1.98	2532	2.16	2598	2.34
4200	2710	2362	1.83	2422	1.95	2476	2.06	2526	2.18	2572	2.29	2614	2.40	2654	2.50	2726	2.70	2791	2.91
4600	2968	2565	2.36	2620	2.50	2673	2.62	2722	2.75	2767	2.87	2809	3.00	2848	3.11	2920	3.34	2985	3.55

CFM	OV	2" SP		2-1/2" SP		3" SP		3-1/2" SP		4" SP		4-1/2" SP		5" SP		5-1/2" SP		6" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1700	1097	1892	0.89	2086	1.16	2273	1.46												
1800	1161	1912	0.94	2099	1.21	2280	1.51	2454	1.82										
1900	1226	1937	0.98	2115	1.26	2290	1.56	2459	1.87										
2000	1290	1964	1.04	2135	1.31	2303	1.62	2467	1.93	2627	2.27								
2100	1355	1995	1.08	2159	1.37	2321	1.67	2479	2.00	2634	2.33	2785	2.70						
2200	1419	2028	1.14	2186	1.43	2341	1.72	2494	2.06	2645	2.41	2792	2.77	2935	3.16				
2300	1484	2063	1.20	2215	1.48	2365	1.79	2513	2.12	2658	2.47	2801	2.84	2941	3.24	3078	3.64		
2400	1548	2101	1.28	2247	1.56	2392	1.87	2534	2.20	2675	2.56	2814	2.92	2950	3.32	3084	3.72	3215	4.15
2500	1613	2139	1.35	2281	1.63	2421	1.95	2558	2.27	2695	2.63	2829	3.00	2962	3.40	3092	3.80	3221	4.24
2600	1677	2180	1.41	2317	1.72	2452	2.02	2585	2.37	2717	2.72	2847	3.09	2976	3.49	3104	3.90	3229	4.33
3000	1935	2351	1.77	2475	2.08	2596	2.41	2714	2.75	2831	3.12	2946	3.50	3061	3.90	3175	4.33	3288	4.76
3400	2194	2532	2.18	2648	2.52	2760	2.87	2867	3.24	2973	3.62	3077	4.01	3180	4.42	3282	4.85	3384	5.30
3800	2452	2719	2.70	2830	3.06	2935	3.44	3036	3.82	3133	4.22	3229	4.62	3323	5.05	3417	5.50	3509	5.94
4200	2710	2910	3.29	3017	3.69	3118	4.08	3213	4.50	3305	4.91	3395	5.34	3483	5.80	3568	6.25	3655	6.71
4600	2968	3102	3.99	3208	4.41	3305	4.84	3397	5.29	3485	5.73	3570	6.19	3654	6.66	3735	7.13	3815	7.61
5000	3226	3296	4.79	3400	5.25	3495	5.72	3585	6.19	3670	6.66	3752	[illegible]	[illegible]	7.63	3909	8.13	3985	8.64
5400	3484	3490	5.69	3593	6.19	3687	6.69	3775	7.20	3856	7.70	3938	[illegible]	[illegible]	8.74	4089	9.25	4162	9.80
5800	3742	3685	6.70	3787	7.25	3880	7.80	3967	8.35	4048	8.89	4126	[illegible]	[illegible]	9.98	4274	10.53	4345	11.08
6200	4000	3878	7.84	3981	8.44	4074	9.03	4160	9.81	4240	10.19	4317	[illegible]	[illegible]	11.35	4461	11.94	4530	12.53
6600	4258	4074	9.11	4176	9.76	4268	10.39	4353	11.03	4433	11.84	4509	[illegible]	[illegible]	12.86	4651	13.48	4719	14.11

CFM	OV	6-1/2" SP		7" SP		7-1/2" SP		8" SP		9" SP		10" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2500	1613	3346	4.67										
2600	1677	3352	4.77	3473	5.23								
3000	1935	3399	5.22	3510	5.69	3620	6.16	3728	[illegible]	[illegible]	7.69		
3400	2194	3485	5.75	3585	6.24	3685	6.73	3784	[illegible]	[illegible]	8.28	4173	9.39
3800	2452	3601	6.41	3692	6.91	3783	7.41	3873	[illegible]	[illegible]	8.99	4230	10.10
4200	2710	3739	7.20	3823	7.69	3907	8.21	3990	[illegible]	[illegible]	9.82	4318	10.96
4600	2968	3894	8.11	3972	8.63	4050	9.14	4127	9.69	4279	10.80	4430	11.94
5000	3226	4060	9.16	4134	9.69	4207	10.23	4279	10.78	4422	11.91	4563	13.08
5400	3484	4234	10.33	4304	10.88	4374	11.44	4442	12.01	4577	13.17	4710	14.38
5800	3742	4414	11.66	4481	12.23	4548	12.81	4613	13.39				
6200	4000	4597	13.11	4663	13.71	4727	14.33						

BHP does not include drive loss.
Underlined figures indicate maximum static efficiency.
Performance shown is for fan with outlet duct.



กราฟ ฌ.2 กราฟแสดงสมรรถนะของพัดลม YORK (BI DWDI) ขนาด 13.5″

ตาราง ฌ.2 ชุดข้อมูลพัดลม YORK (BI DWDI) ขนาด 13.25″

FORM 100.02-EG1 (SUPL 1)

13-1/2″ BI DWDI

NLET AREA = 2.240 SQ. FT. • WHEEL DIAMETER 13-1/2″
DISCHARGE AREA = 1.89 SQ. FT. • TIP SPEED F.P.M. = 3.53 x R.P.M. • MAXIMUM B.H.P. = $.2305 \left(\frac{R.P.M.}{1000}\right)^3$

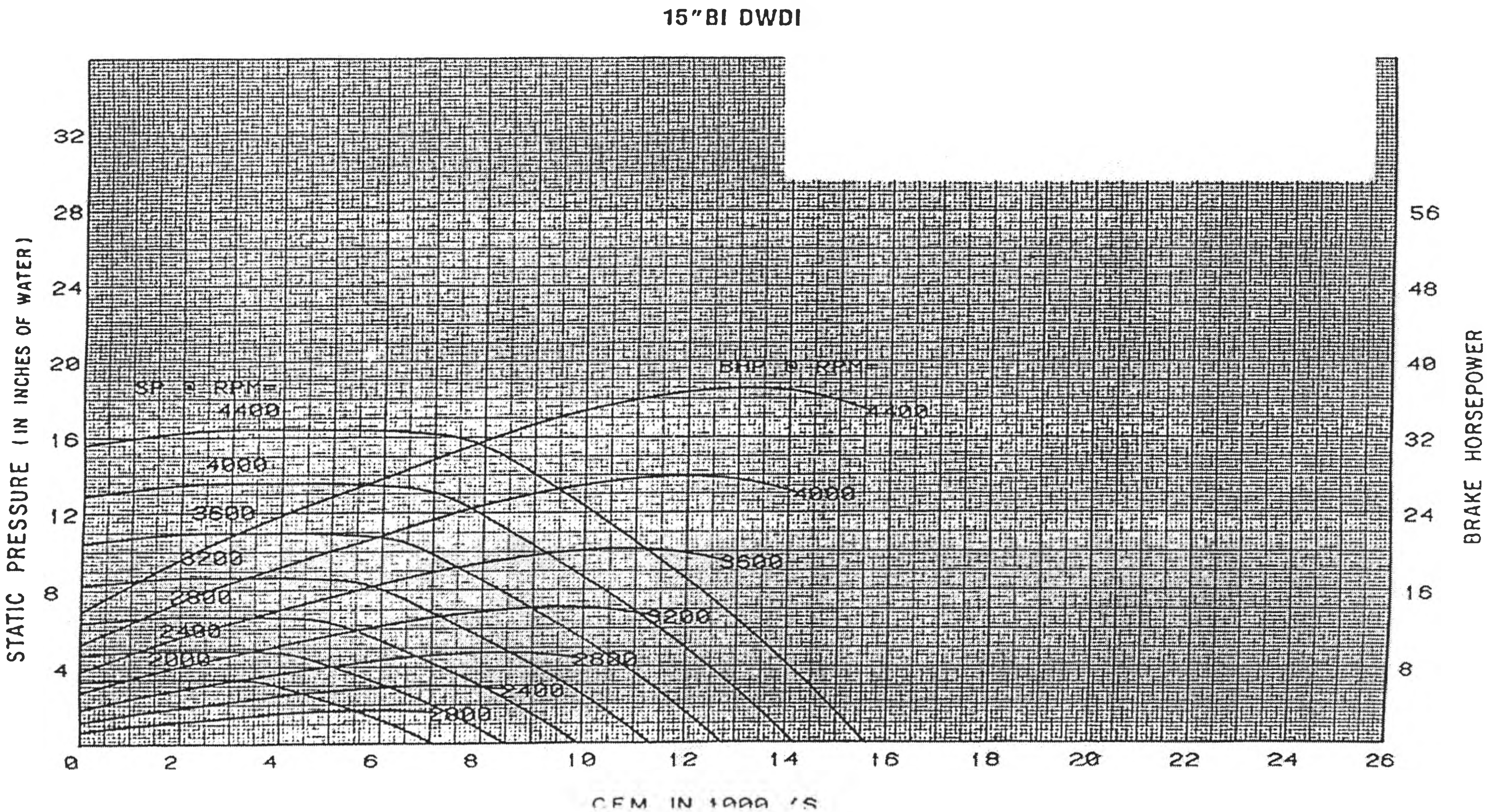
Top white area is Class I. Top gray area is Class II.

CFM	OV	1/4″ SP RPM	1/4″ SP BHP	3/8″ SP RPM	3/8″ SP BHP	1/2″ SP RPM	1/2″ SP BHP	5/8″ SP RPM	5/8″ SP BHP	3/4″ SP RPM	3/4″ SP BHP	7/8″ SP RPM	7/8″ SP BHP	1″ SP RPM	1″ SP BHP	1-1/4″ SP RPM	1-1/4″ SP BHP	1-1/2″ SP RPM	1-1/2″ SP BHP
[illegible]	[illegible]	826	0.12	898	0.16	965	0.20	1030	0.25	1094	0.29	1157	0.34	1220	0.40	1342	0.51	1460	0.64
1600	[illegible]	861	0.14	931	0.17	995	0.22	1057	0.26	1118	0.30	1177	0.35	1237	0.41	1353	0.54	1467	0.65
[illegible]	899	897	0.16	965	0.20	1027	0.24	1086	0.29	1144	0.34	1200	0.39	1257	0.44	1367	0.56	1476	0.68
1800	[illegible]	932	0.17	999	0.22	1059	0.26	1116	0.30	1172	0.35	1226	0.40	1279	0.46	1385	0.59	1488	0.71
1900	1005	968	0.20	1034	0.24	1093	0.29	1148	0.34	1201	0.39	1253	0.44	1304	0.50	1405	0.61	1504	0.75
2000	1058	1004	0.22	1069	0.27	1127	0.30	1180	0.35	1232	0.41	1282	0.46	1331	0.53	1427	0.64	1522	0.78
2100	1111	1040	0.24	1105	0.29	1161	0.34	1213	0.39	1263	0.45	1312	0.50	1358	0.56	1452	0.69	1543	0.82
2200	1164	1077	0.27	1140	0.32	1196	0.36	1247	0.43	1296	0.48	1343	0.54	1389	0.60	1478	0.71	1566	0.86
2300	1217	1113	0.30	1176	0.34	1231	0.40	1282	0.45	1329	0.52	1375	0.58	1419	0.64	1506	0.76	1590	0.89
2400	1270	1149	0.32	1212	0.39	1267	0.44	1316	0.50	1363	0.56	1408	0.61	1451	0.68	1535	0.81	1616	0.94
2500	1323	1186	0.35	1248	0.41	1302	0.48	1351	0.54	1397	0.60	1441	0.65	1483	0.71	1565	0.86	1644	1.00
2600	1376	1222	0.40	1284	0.45	1338	0.52	1386	0.58	1432	0.64	1475	0.70	1516	0.77	1596	0.91	1673	1.04
2700	1429	1258	0.44	1321	0.50	1374	0.56	1422	0.63	1467	0.68	1509	0.76	1550	0.81	1627	0.96	1702	1.10
2800	1481	1295	0.48	1357	0.54	1410	0.60	1458	0.66	1502	0.73	1544	0.81	1583	0.86	1660	1.01	1733	1.16
3300	1746	1477	0.70	1539	0.80	1591	0.88	1638	0.94	1680	1.03	1720	1.11	1758	1.18	1829	1.33	1896	1.50
3800	2011	1660	1.02	1721	1.12	1773	1.21	1819	1.31	1861	1.39	1900	1.48	1936	1.58	2004	1.76	2068	1.92
4300	2275	1844	1.41	1903	1.53	1955	1.63	2001	1.75	2043	1.86	2081	1.95	2117	2.06	2184	2.25	2245	2.45
4800	2540	2030	1.88	2086	2.02	2137	2.16	2183	2.29	2224	2.41	2263	2.52	2298	2.63	2364	2.87	2424	3.09
5300	2804	2219	2.47	2271	2.62	2320	2.77	2365	2.92	2406	3.07	2445	3.20	2480	3.33	2546	3.59	2605	3.84
5800	3069	2409	3.17	2457	3.34	2504	3.52	2548	3.67	2589	3.84	2627	3.99	2662	4.14	2727	4.42	2796	4.70

CFM	OV	2″ SP RPM	2″ SP BHP	2-1/2″ SP RPM	2-1/2″ SP BHP	3″ SP RPM	3″ SP BHP	3-1/2″ SP RPM	3-1/2″ SP BHP	4″ SP RPM	4″ SP BHP	4-1/2″ SP RPM	4-1/2″ SP BHP	5″ SP RPM	5″ SP BHP	5-1/2″ SP RPM	5-1/2″ SP BHP	6″ SP RPM	6″ SP BHP
2000	1058	1709	1.06	1889	1.39														
2100	1111	1722	1.11	1896	1.43	2064	1.79												
2200	1164	1738	1.14	1906	1.47	2070	1.83	2227	2.22										
2300	1217	1756	1.20	1918	1.53	2077	1.88	2231	2.27										
2400	1270	1776	1.25	1933	1.58	2087	1.95	2237	2.33	2383	2.75								
2500	1323	1798	1.29	1950	1.63	2099	2.00	2245	2.40	2387	2.81	2525	3.25						
2600	1376	1822	1.35	1969	1.68	2113	2.06	2255	2.45	2394	2.87	2529	3.32	2661	3.79				
2700	1429	1847	1.41	1989	1.75	2129	2.12	2267	2.52	2402	2.95	2535	3.39	2664	3.85				
2800	1481	1874	1.47	2012	1.82	2147	2.18	2281	2.58	2413	3.02	2542	3.47	2669	3.94	2793	4.42		
3300	1746	2022	1.83	2143	2.20	2261	2.58	2377	3.00	2492	3.44	2606	3.90	2719	4.37	2831	4.87	2942	5.41
3800	2011	2185	2.29	2296	2.68	2402	3.09	2506	3.52	2608	3.97	2709	4.44	2809	4.94	2909	5.44	3008	5.98
4300	2275	2357	2.87	2461	3.29	2559	3.72	2654	4.16	2747	4.64	2839	5.12	2929	5.62	3019	6.16	3108	6.69
4800	2540	2533	3.54	2632	4.00	2726	4.45	2815	4.94	2902	5.42	2986	5.94	3069	6.46	3151	7.00	3233	7.56
5300	2804	2712	4.33	2808	4.83	2898	5.33	2984	5.83	3066	6.37	3145	6.90	3223	[illegible]	3299	8.01	3375	8.58
5300	3069	2892	5.25	2987	5.80	3074	6.33	3157	6.89	3236	[illegible]	3312	8.00	3386	[illegible]	3458	9.27	3529	9.78
6300	3333	3073	6.30	3167	6.90	3253	7.49	3333	8.08	3410	8.58	3483	9.26	[illegible]	[illegible]	3623	10.50	3691	11.13
6800	3598	3255	7.50	3348	8.14	3433	8.78	3512	9.41	3587	10.05	3658	10.59	[illegible]	[illegible]	3794	12.00	3859	12.66
7300	3862	3437	8.85	3529	9.65	3613	10.25	3692	10.92	3765	11.60	3835	12.28	[illegible]	[illegible]	3968	13.66	4031	14.36
7800	4127	3618	10.36	3711	11.13	3795	11.88	3872	12.60	3945	13.33	4014	14.07	[illegible]	[illegible]	4144	15.51	4206	16.26
8300	4392	3800	12.05	3892	12.88	3976	13.67	4053	14.36	4126	15.25	4194	16.03	4259	16.79				

CFM	OV	6-1/2″ SP RPM	6-1/2″ SP BHP	7″ SP RPM	7″ SP BHP	7-1/2″ SP RPM	7-1/2″ SP BHP	8″ SP RPM	8″ SP BHP	9″ SP RPM	9″ SP BHP	10″ SP RPM	10″ SP BHP
3300	1746	3051	5.94	3158	6.50	3263	7.08	3366	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3800	2011	3106	6.54	3204	7.10	3300	7.69	[illegible]	[illegible]	3584	9.57	3767	10.89
4300	2275	3195	7.26	3284	[illegible]	3372	[illegible]	[illegible]	[illegible]	3631	10.35	3802	11.69
4800	2540	3313	[illegible]	3393	8.74	3473	9.35	[illegible]	[illegible]	3710	11.26	3866	12.64
5300	2804	3449	[illegible]	3523	9.80	3596	[illegible]	[illegible]	[illegible]	3814	12.69	3957	13.78
5800	3069	3591	[illegible]	3668	11.09	3736	[illegible]	[illegible]	[illegible]	3938	13.68	4074	15.10
6300	3333	3757	11.76	3823	[illegible]	3887	[illegible]	3951	[illegible]	4077	15.16	4201	[illegible]
6800	3598	3922	[illegible]	3985	14.01	[illegible]	[illegible]	[illegible]	[illegible]	4227	16.85		
7300	3862	4092	15.07	4153	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
7800	4127	[illegible]	17.00										

BHP does not include drive loss.
Underlined figures indicate maximum static efficiency.
Performance shown is for fan with outlet duct



กราฟ ฌ.3 กราฟแสดงสมรรถนะของพัดลม YORK (BI DWDI) ขนาด 15.0″

ตาราง ฌ.3 ชุดข้อมูลพัดลม YORK (BI DWDI) ขนาด 15.0″

15"BI DWDI

NLET AREA = 2.780 SQ. FT. • WHEEL DIAMETER 15"
DISCHARGE AREA = 2.33 SQ. FT. • TIP SPEED F.P.M. = 3.93 x R.P.M. • MAXIMUM B.H.P. = .3903 $\left(\frac{R.P.M.}{1000}\right)^3$

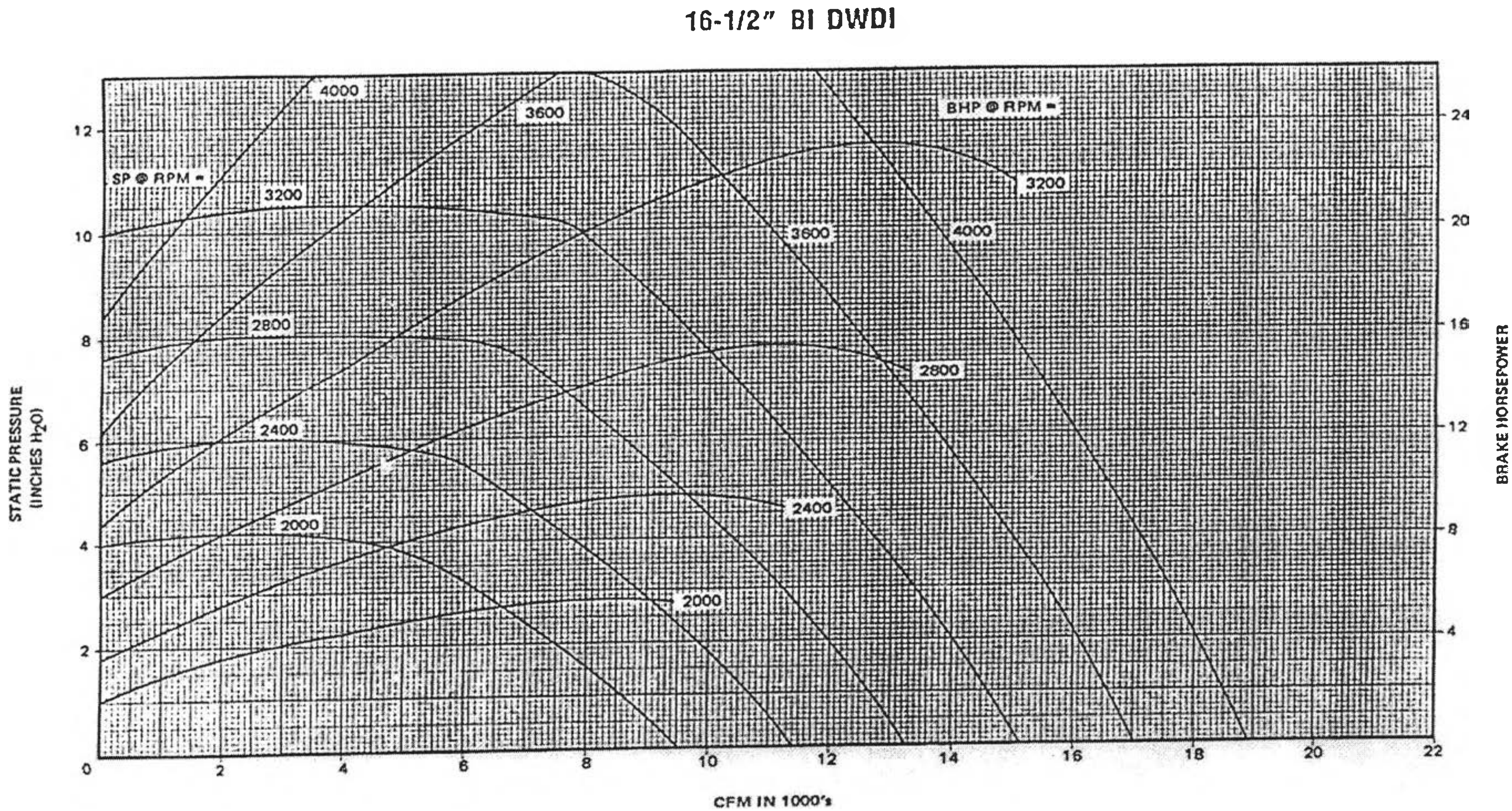
Top white area is Class I. Top gray area is Class II.

CFM	OV	1/4" SP		3/8" SP		1/2" SP		5/8" SP		3/4" SP		7/8" SP		1" SP		1-1/4" SP		1-1/2" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
1900	815	756	0.16	820	0.20	879	0.26	937	0.30	993	0.36	1048	0.43	1103	0.50	1211	0.64	1316	0.80
2000	858	781	0.17	844	0.22	901	0.28	957	0.32	1010	0.39	1064	0.44	1116	0.52	1220	0.66	1321	0.81
2100	901	807	0.19	869	0.24	924	0.30	978	0.34	1030	0.40	1081	0.48	1131	0.55	1231	0.68	1328	0.85
2200	944	833	0.20	894	0.27	948	0.32	1000	0.38	1050	0.44	1099	0.50	1147	0.56	1243	0.71	1337	0.88
2300	987	859	0.22	919	0.29	972	0.34	1022	0.40	1071	0.46	1118	0.53	1165	0.60	1257	0.75	1348	0.91
2400	1030	886	0.26	944	0.30	997	0.36	1046	0.43	1093	0.48	1139	0.56	1184	0.63	1273	0.78	1360	0.93
2500	1073	912	0.28	970	0.34	1022	0.40	1070	0.45	1116	0.52	1160	0.59	1204	0.65	1290	0.81	1374	0.97
2600	1116	938	0.30	996	0.35	1047	0.43	1094	0.48	1139	0.56	1182	0.61	1225	0.69	1308	0.85	1390	1.01
2700	1159	965	0.32	1022	0.39	1072	0.45	1119	0.52	1162	0.59	1205	0.65	1246	0.72	1327	0.88	1406	1.04
2800	1202	991	0.35	1048	0.41	1098	0.48	1143	0.56	1187	0.63	1228	0.69	1268	0.77	1347	0.93	1424	1.08
2900	1245	1018	0.39	1074	0.45	1124	0.52	1169	0.59	1211	0.65	1252	0.73	1291	0.81	1368	0.96	1442	1.13
3000	1288	1044	0.41	1101	0.48	1149	0.56	1194	0.63	1236	0.69	1276	0.78	1314	0.85	1389	1.02	1462	1.18
3100	1330	1071	0.44	1127	0.53	1176	0.60	1220	0.66	1261	0.75	1300	0.81	1338	0.89	1411	1.06	1482	1.23
3700	1588	1230	0.68	1286	0.78	1333	0.86	1375	0.96	1415	1.04	1451	1.12	1486	1.21	1553	1.39	1616	1.58
4300	1845	1389	1.01	1445	1.12	1492	1.22	1534	1.33	1572	1.43	1607	1.53	1641	1.62	1703	1.82	1762	2.04
4900	2103	1550	1.41	1604	1.54	1651	1.67	1692	1.79	1730	1.91	1765	2.02	1798	2.13	1858	2.37	1914	2.59
5500	2361	1712	1.91	1764	2.07	1810	2.20	1851	2.36	1889	2.49	1924	2.62	1956	2.75	2015	3.00	2070	3.27
6100	2618	1875	2.52	1924	2.70	1970	2.87	2011	3.02	2048	3.18	2083	3.34	2115	3.49	2174	3.77	2228	4.07
6700	2876	2040	3.27	2086	3.45	2130	3.65	2170	3.84	2207	4.00	2242	4.19	2274	4.34	2333	4.67	2386	5.00
7300	3133	2207	4.15	2250	4.35	2291	4.57	2330	4.77	2367	4.98	2401	5.16	2433	5.35	2492	5.72	2545	6.08

CFM	OV	2" SP		2-1/2" SP		3" SP		3-1/2" SP		4" SP		4-1/2" SP		5" SP		5-1/2" SP		6" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2400	1030	1532	1.29	1687	1.70														
2500	1073	1540	1.33	1701	1.73	1855	2.17												
2600	1116	1550	1.37	1707	1.77	1858	2.22												
2700	1159	1562	1.41	1714	1.82	1862	2.27	2004	2.74										
2800	1202	1575	1.45	1723	1.87	1867	2.32	2007	2.79										
2900	1245	1589	1.51	1733	1.92	1873	2.37	2010	2.84	2143	3.35								
3000	1288	1604	1.56	1744	1.97	1881	2.41	2015	2.91	2145	3.41								
3100	1330	1621	1.61	1757	2.02	1890	2.47	2021	2.97	2149	3.47	2273	4.02						
3700	1588	1737	1.98	1854	2.41	1969	2.87	2083	3.37	2195	3.90	2306	4.47	2416	5.05	2523	5.66	2628	6.30
4300	1845	1872	2.47	1977	2.91	2079	3.40	2179	3.91	2278	4.47	2376	5.04	2473	5.64	2570	6.26	2665	6.91
4900	2103	2018	3.07	2115	3.54	2208	4.07	2299	4.59	2388	5.16	2475	5.75	2562	6.37	2649	7.00	2734	7.66
5500	2361	2170	3.77	2262	4.30	2348	4.85	2433	5.42	2514	6.00	2595	6.61	2674	7.25	2752	7.91	2830	8.58
6100	2618	2325	4.64	2414	5.20	2497	5.80	2576	6.40	2652	7.01	2727	7.65	2800	8.30	2873	8.99	2944	9.67
6700	2876	2482	5.62	2568	6.25	2648	6.88	2724	7.51	2797	8.17	2868	8.85	2937	9.53	3005	10.24	3072	10.96
7300	3133	2640	6.76	2725	7.44	2803	8.13	2877	8.82	2947	9.50	3015	10.21	3081	10.94	3145	11.67	3208	12.42
7900	3391	2798	8.07	2882	8.80	2959	9.55	3032	10.28	3100	11.03	3166	[illegible]	3229	12.53	3291	13.31	3351	14.10
8500	3648	2957	9.53	3041	10.35	3117	11.14	3188	11.92	3255	12.73	3319	[illegible]	3381	14.33	3441	15.13	3499	15.96
9100	3906	3116	11.19	3199	12.07	3275	12.91	3345	13.76	3412	14.61	3474	[illegible]	3535	16.32	3593	17.17	3650	18.04
9700	4163	3275	13.03	3358	13.98	3434	14.91	3503	15.82	3569	16.73	3631	[illegible]	[illegible]	18.53	3748	19.43	3803	20.35
10300	4421	3434	15.07	3517	16.10	3593	17.10	3662	18.07	3727	19.03	3788	20.01	3847	20.96	3904	21.92	3958	22.89

CFM	OV	6-1/2" SP		7" SP		7-1/2" SP		8" SP		9" SP		10" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3700	1588	2732	6.96										
4300	1845	2760	7.58	2853	8.28	2945	9.00	3036	9.75				
4900	2103	2820	8.35	2904	9.07	2989	[illegible]	[illegible]	10.55	3237	12.11	3398	13.76
5500	2361	2907	9.28	2984	10.00	3060	[illegible]	[illegible]	11.51	3287	13.11	3436	14.78
6100	2618	3015	10.39	3085	11.14	3155	[illegible]	[illegible]	12.67	3363	14.30	3500	15.98
6700	2876	3137	11.69	3203	12.46	3267	[illegible]	[illegible]	14.03	3459	15.67	3586	17.41
7300	3133	3270	13.19	3332	13.98	3392	[illegible]	[illegible]	15.60	3572	17.28	3689	19.03
7900	3391	3411	14.89	3469	15.71	3526	16.53	3583	17.39	3695	19.11	3806	20.92
8500	3648	3556	16.81	3612	17.64	3667	18.51	3721	19.39	3828	21.17		
9100	3906	3705	18.92	3759	19.82	3812	20.71	3864	21.61				
9700	4163	3857	21.28										

BHP does not include drive loss
Underlined figures indicate maximum static efficiency
Performance shown is for fan with outlet duct



กราฟ ฌ.4 กราฟแสดงสมรรถนะของพัดลม YORK (BI DWDI) ขนาด 16.25″

ตาราง ฌ.5 ชุดข้อมูลพัดลม YORK (BI DWDI) ขนาด 16.5″

16-1/2″ BI DWDI

INLET AREA = 3.340 SQ. FT. • WHEEL DIAMETER 16-1/2″
DISCHARGE AREA = 2.82 SQ. FT. • TIP SPEED F.P.M. = 4.32 x R.P.M. • MAXIMUM B.H.P. = $.6287 \left(\frac{R.P.M.}{1000}\right)^3$

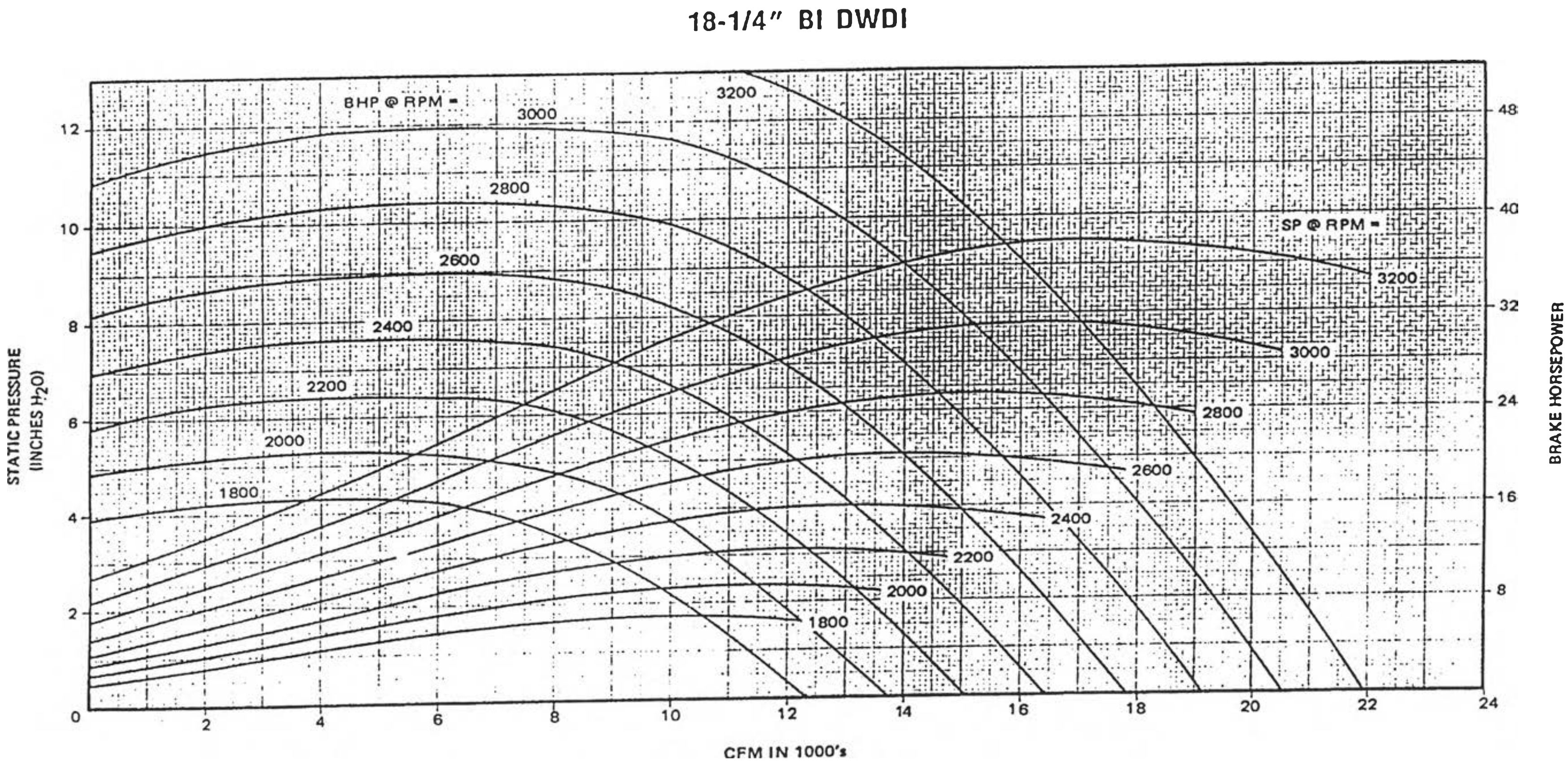
Top white area is Class I. Top gray area is Class II.

CFM	OV	1/4″ SP		3/8″ SP		1/2″ SP		5/8″ SP		3/4″ SP		7/8″ SP		1″ SP		1-1/4″ SP		1-1/2″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2200	780	668	0.17	728	0.22	763	0.29	837	0.35	890	0.43	943	0.50	995	0.58	1096	0.76	1194	0.94
2400	851	707	0.20	764	0.27	816	0.32	867	0.40	916	0.46	965	0.55	1013	0.63	1106	0.80	1200	0.98
2600	922	745	0.25	801	0.30	851	0.36	898	0.44	945	0.52	990	0.59	1035	0.68	1124	0.85	1211	1.04
2800	993	785	0.29	839	0.34	887	0.41	932	0.48	976	0.56	1019	0.64	1062	0.72	1145	0.91	1227	1.11
3000	1064	824	0.32	877	0.40	924	0.46	968	0.55	1010	0.63	1051	0.70	1091	0.79	1169	0.96	1247	1.16
3200	1135	864	0.38	916	0.45	962	0.53	1004	0.60	1045	0.68	1084	0.77	1122	0.86	1197	1.04	1270	1.25
3400	1206	903	0.44	955	0.52	1000	0.60	1042	0.68	1081	0.76	1119	0.85	1155	0.93	1226	1.12	1296	1.33
3600	1277	943	0.50	995	0.58	1039	0.66	1080	0.75	1118	0.83	1154	0.93	1190	1.02	1258	1.20	1325	1.41
3800	1348	983	0.56	1034	0.65	1078	0.73	1118	0.83	1155	0.91	1191	1.02	1225	1.11	1291	1.31	1355	1.52
4000	1418	1023	0.64	1074	0.72	1118	0.83	1157	0.91	1194	1.02	1228	1.11	1262	1.20	1326	1.41	1387	1.62
4200	1489	1063	0.71	1114	0.81	1157	0.91	1196	1.02	1232	1.11	1266	1.20	1299	1.31	1361	1.53	1421	1.73
4400	1560	1103	0.80	1153	0.91	1197	1.02	1235	1.12	1271	1.21	1304	1.31	1336	1.43	1397	1.64	1455	1.87
4600	1631	1142	0.89	1193	1.01	1236	1.12	1275	1.22	1310	1.33	1343	1.43	1375	1.54	1434	1.77	1491	2.00
4800	1702	1182	1.00	1233	1.12	1276	1.22	1314	1.33	1349	1.45	1382	1.56	1413	1.67	1472	1.91	1527	2.15
5500	1950	1322	1.39	1373	1.54	1415	1.68	1453	1.82	1488	1.95	1520	2.08	1550	2.20	1606	2.45	1658	2.72
6200	2199	1464	1.92	1512	2.08	1555	2.25	1593	2.41	1627	2.56	1658	2.70	1688	2.84	1743	3.13	1793	3.42
6900	2447	1606	2.54	1653	2.74	1694	2.92	1732	3.11	1766	3.27	1797	3.45	1827	3.62	1881	3.94	1930	4.25
7600	2695	1750	3.30	1794	3.52	1835	3.74	1872	3.95	1906	4.14	1937	4.33	1966	4.51	2020	4.89	2068	5.24
8300	2943	1895	4.22	1936	4.45	1975	4.69	2012	4.92	2045	5.15	2076	5.35	2106	5.57	2159	5.98	2207	6.37
9000	3191	2041	5.29	2079	5.55	2117	5.80	2152	6.07	2185	6.30	2216	6.55	2245	6.79	2298	7.24	2347	7.68

CFM	OV	2″ SP		2-1/2″ SP		3″ SP		3-1/2″ SP		4″ SP		4-1/2″ SP		5″ SP		5-1/2″ SP		6″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3200	1135	1414	1.68	1555	2.17	1691	2.70												
3400	1206	1433	1.77	1567	2.27	1698	2.81	1824	3.39										
3600	1277	1455	1.87	1583	2.37	1708	2.91	1831	3.50	1950	4.12								
3800	1348	1480	1.97	1602	2.47	1722	3.02	1840	3.62	1955	4.25	2068	4.91						
4000	1418	1507	2.08	1624	2.59	1739	3.15	1852	3.75	1962	4.37	2073	5.04	2179	5.74				
4200	1489	1536	2.20	1648	2.72	1759	3.29	1868	3.87	1975	4.51	2081	5.19	2185	5.90	2286	6.63		
4400	1560	1567	2.34	1675	2.87	1781	3.42	1886	4.02	1989	4.66	2092	5.34	2192	6.05	2291	6.80	2388	7.55
4600	1631	1599	2.49	1703	3.02	1805	3.59	1906	4.19	2006	4.83	2105	5.51	2203	6.23	2299	6.98	2393	7.75
4800	1702	1632	2.65	1733	3.17	1832	3.75	1929	4.35	2025	5.00	2121	5.69	2215	6.41	2309	7.16	2401	7.94
5500	1950	1756	3.25	1848	3.83	1937	4.42	2024	5.05	2109	5.73	2194	6.43	2279	7.16	2362	7.91	2445	8.71
6200	2199	1886	4.01	1972	4.62	2054	5.25	2134	5.91	2212	6.60	2289	7.33	2365	8.08	2441	8.85	2516	9.66
6900	2447	2020	4.91	2102	5.57	2180	6.24	2255	6.94	2327	7.66	2398	8.41	2468	9.17	2537	9.99	2606	10.80
7600	2695	2157	5.94	2236	6.66	2311	7.39	2382	8.13	2450	8.89	2517	9.66	2582	10.48	2647	11.30	2710	12.16
8300	2943	2294	7.16	2372	7.93	2445	8.71	2513	9.50	2579	10.30	2642	11.13	2704	11.96	2765	12.83	2825	13.71
9000	3191	2433	8.53	2510	9.36	2581	10.21	2648	11.05	2731	11.91	2772	12.78	2831	13.66	2889	14.57	2946	15.48
9700	3440	2572	10.08	2648	11.00	2718	11.91	2784	12.81	2845	13.71	[illegible]	[illegible]	2962	15.57	3018	16.51	3072	17.48
10400	3688	2711	11.83	2787	12.83	2856	13.81	2923	14.78	2982	15.75	[illegible]	[illegible]	3096	17.70	3150	18.70	3202	19.71
11100	3936	2851	13.80	2926	14.86	2995	15.91	3059	16.96	3119	17.98	[illegible]	[illegible]	3231	20.07	3264	21.10	3335	22.17
11800	4184	2990	15.96	3066	17.13	3134	18.26	3197	19.36	3257	20.46	[illegible]	[illegible]	3367	22.67	3419	23.76	3470	24.88
12500	4433	3130	18.35	3205	19.61	3273	20.82	3336	22.01	3395	23.18	3451	24.35	3505	25.51				

CFM	OV	6-1/2″ SP		7″ SP		7-1/2″ SP		8″ SP		9″ SP		10″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4600	1631	2486	8.55	2576	9.36								
4800	1702	2491	8.75	2580	9.58	2667	10.24						
5500	1950	2528	9.53	2610	10.39	2690	11.26	2770	12.16	2927	14.05	3079	16.01
6200	2199	2590	10.50	2665	11.36	2738	12.25	[illegible]	[illegible]	2957	15.08	3099	17.10
6900	2447	2674	11.66	2742	12.65	2809	13.44	[illegible]	[illegible]	3009	16.32	[illegible]	18.85
7600	2695	2773	13.03	2836	13.93	2898	14.86	[illegible]	[illegible]	3082	17.78	3204	19.83
8300	2943	2884	14.61	2942	15.53	3000	16.48	[illegible]	[illegible]	3121	19.76	3284	21.56
9000	3191	3002	16.42	3057	17.38	3111	18.35	3165	19.35	3272	21.81	3377	23.53
9700	3440	3126	18.46	3178	19.45	3230	20.46	3281	21.48	3382	23.60	3482	25.77
10400	3688	3254	20.71	3305	21.76	3354	22.81	3403	23.86	3499	26.04		
11100	3936	3385	23.23	3434	24.32	3482	25.41						
11800	4184	3518	26.00										

BHP does not include drive loss.
Underlined figures indicate maximum static efficiency.
Performance shown is for fan with outlet duct.



กราฟ ฌ.5 กราฟแสดงสมรรถนะของพัดลม YORK (BI DWDI) ขนาด 18.25″

ตาราง ฌ.5 ชุดข้อมูลพัดลม YORK (BI DWDI) ขนาด 18.25″

18-1/4″ BI DWDI

INLET AREA = 4.050 SQ. FT. • WHEEL DIAMETER 18-1/4″
DISCHARGE AREA = 3.45 SQ. FT. • TIP SPEED F.P.M. = 4.78 x R.P.M. • MAXIMUM B.H.P. = 1.200 $\left(\frac{R.P.M.}{1000}\right)^3$

Top white area is Class I. Top gray area is Class II.

CFM	OV	1/4″ SP		3/8″ SP		1/2″ SP		5/8″ SP		3/4″ SP		7/8″ SP		1″ SP		1-1/4″ SP		1-1/2″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2800	812	563	0.20	624	0.27	678	0.34	729	0.40	778	0.48	825	0.58	871	0.65	959	0.85		
3200	928	607	0.26	665	0.32	717	0.40	765	0.48	810	0.56	853	0.65	896	0.75	977	0.94	1055	1.14
3600	1043	652	0.32	709	0.40	758	0.48	804	0.58	847	0.66	887	0.76	927	0.86	1003	1.06	1076	1.27
4000	1159	697	0.40	752	0.50	801	0.59	845	0.68	886	0.78	925	0.86	963	0.96	1034	1.18	1103	1.41
4400	1275	744	0.48	797	0.60	845	0.69	888	0.80	928	0.89	965	1.01	1001	1.11	1070	1.33	1135	1.56
4800	1391	791	0.59	842	0.70	889	0.81	931	0.93	970	1.04	1007	1.14	1042	1.27	1108	1.50	1170	1.73
5200	1507	840	0.70	889	0.83	934	0.96	975	1.06	1014	1.20	1050	1.31	1084	1.43	1148	1.68	1208	1.93
5600	1623	890	0.85	936	0.97	979	1.12	1020	1.25	1058	1.37	1093	1.51	1127	1.63	1189	1.89	1248	2.16
6000	1739	941	1.00	984	1.13	1026	1.29	1065	1.43	1102	1.56	1137	1.70	1170	1.85	1232	2.12	1289	2.40
6400	1855	993	1.16	1033	1.31	1073	1.47	1111	1.62	1147	1.77	1182	1.92	1214	2.08	1275	2.37	1331	2.66
6800	1971	1046	1.37	1083	1.53	1120	1.68	1157	1.85	1193	2.02	1227	2.17	1259	2.33	1318	2.65	1374	2.95
7200	2087	1099	1.58	1134	1.75	1169	1.92	1204	2.09	1239	2.27	1272	2.43	1303	2.61	1362	2.93	1417	3.27
7600	2203	1153	1.82	1185	2.00	1219	2.17	1252	2.36	1285	2.54	1318	2.72	1349	2.91	1407	3.25	1461	3.60
8000	2319	1208	2.09	1238	2.27	1269	2.45	1301	2.65	1333	2.83	1364	3.02	1394	3.22	1452	3.59	1505	3.97
8400	2435	1263	2.40	1290	2.57	1320	2.75	1350	2.95	1381	3.16	1411	3.37	1440	3.57	1497	3.97	1549	4.35
8800	2551	1318	2.72	1344	2.90	1372	3.09	1400	3.29	1429	3.50	1459	3.72	1487	3.94	1542	4.35	1594	4.77
9200	2667	1373	3.08	1398	3.25	1424	3.45	1451	3.66	1479	3.89	1507	4.10	1534	4.33	1588	4.77	1639	5.22
9600	2783	1429	3.45	1452	3.65	1477	3.85	1503	4.07	1529	4.30	1556	4.52	1582	4.75	1635	5.22	1685	5.67
10000	2899	1485	3.87	1507	4.08	1530	4.29	1555	4.50	1580	4.74	1605	4.97	1631	5.20	1682	5.69	1731	6.17
10400	3014	1541	4.33	1562	4.52	1584	4.75	1607	4.98	1631	5.20	1655	5.44	1680	5.69	1729	6.19	1777	6.70

CFM	OV	2″ SP		2-1/2″ SP		3″ SP		3-1/2″ SP		4″ SP		4-1/2″ SP		5″ SP		5-1/2″ SP		6″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
4400	1275	1258	2.07	1375	2.61	1488	3.19												
4800	1391	1287	2.25	1399	2.82	1505	3.41	1609	4.05	1708	4.69								
5200	1507	1320	2.47	1426	3.06	1528	3.66	1627	4.32	1722	5.00	1815	5.69						
5600	1623	1356	2.72	1458	3.32	1555	3.95	1650	4.62	1741	5.30	1831	6.02	1918	6.78	2002	7.55		
6000	1739	1394	2.99	1492	3.59	1586	4.25	1677	4.94	1764	5.65	1850	6.39	1934	7.16	2016	7.94	2096	8.75
6400	1855	1434	3.27	1529	3.90	1620	4.58	1707	5.27	1791	6.01	1874	6.78	1954	7.56	2033	8.38	2111	9.21
6800	1971	1475	3.59	1568	4.25	1656	4.94	1740	5.66	1821	6.41	1901	7.19	1979	8.00	2055	8.83	2130	9.69
7200	2087	1517	3.94	1608	4.62	1693	5.33	1775	6.07	1854	6.83	1931	7.64	2006	8.46	2080	9.30	2152	10.19
7600	2203	1559	4.30	1649	5.01	1732	5.75	1812	6.50	1889	7.30	1963	8.11	2036	8.96	2107	9.83	2177	10.71
8000	2319	1602	4.70	1690	5.44	1772	6.20	1850	6.99	1925	7.80	1998	8.63	2069	9.49	2138	10.38	2206	11.28
8400	2435	1646	5.12	1733	5.91	1814	6.69	1890	7.50	1963	8.33	2034	9.17	2103	10.05	2170	10.96	2236	11.89
8800	2551	1689	5.58	1776	6.40	1855	7.20	1931	8.03	2003	8.89	2072	9.76	2139	10.66	2205	11.58	2269	12.53
9200	2667	1734	6.07	1819	6.91	1898	7.75	1972	8.61	2043	9.50	2111	10.39	2177	11.30	2241	12.25	2304	13.21
9600	2783	1778	6.58	1863	7.46	1941	8.35	2014	9.24	2084	10.14	2151	11.05	[illegible]	12.00	2278	12.96	2340	13.94
10000	2899	1823	7.11	1907	8.05	1984	8.96	2057	9.89	2126	10.82	2191	11.75	[illegible]	[illegible]	2317	13.71	2377	14.71
10400	3014	1868	7.69	1951	8.66	2028	9.61	2100	10.57	2168	11.53	2233	12.50	[illegible]	[illegible]	2356	14.50	2416	15.53
10800	3130	1913	8.30	1995	9.30	2072	10.30	2143	11.30	2210	12.28	2275	13.28	[illegible]	[illegible]	2397	15.33	2455	16.39
11200	3246	1959	8.94	2040	9.99	2116	11.03	2187	12.05	2253	13.08	2317	14.11	2378	15.16	2438	16.21	2495	17.28
12200	3536	2074	10.67	2153	11.83	2227	12.98	2297	14.11	2362	15.23	2425	16.35	2485	17.48	2542	18.60	2598	19.75
13200	3826	2193	12.64	2268	13.92	2340	15.18	2408	16.42	2473	17.64	2534	18.85	2593	20.07	2650	21.28	2704	22.50

CFM	OV	6-1/2″ SP		7″ SP		7-1/2″ SP		8″ SP		9″ SP		10″ SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6800	1971	2203	10.55	2275	11.46	2347	12.38	2416	13.31				
7200	2087	2223	11.08	2293	12.00	2362	12.93	2430	13.89	2563	15.86		
7600	2203	2246	11.64	2314	12.57	2381	13.53	2447	14.51	2576	16.51	2702	18.58
8000	2319	2272	12.21	2338	13.17	2403	14.16	2467	15.16	2592	17.21	2715	19.32
8400	2435	2301	12.83	2365	13.82	[illegible]	[illegible]	2490	15.83	2612	17.92	2731	20.08
8800	2551	2332	13.51	2394	14.50	[illegible]	[illegible]	2516	16.54	2634	18.67		
9200	2667	2365	14.21	2426	15.21	[illegible]	[illegible]	2544	17.29	2659	19.46		
9600	2783	2400	14.94	2459	15.98	[illegible]	[illegible]	2574	18.10	2687	20.31		
10000	2899	2436	15.73	2494	16.78	2551	17.85	2607	18.95	2716	21.18		
10400	3014	2473	16.57	2530	17.64	2586	18.73	2640	19.83				
10800	3130	2512	17.46	2567	18.53	2622	19.64	2676	20.78				
11200	3246	2551	18.38	2606	19.48	2660	20.61	2712	21.76				
12200	3536	2653	20.89	2705	22.07								

BHP does not include drive loss.
Underlined figures indicate maximum static efficiency.
Performance shown is for fan with outlet duct

ประวัติผู้เขียน

นายปณตสรรค์ สูจยานนท์ เกิดวันที่ 14 สิงหาคม 2517 ที่จังหวัดกาฬสินธุ์ สำเร็จการศึกษาปริญญาตรีวิศวกรรมศาสตรบัณฑิต สาขาวิศวกรรมเครื่องกล ภาควิชาวิศวกรรมเครื่องกล คณะวิศวกรรมศาสตร์ มหาวิทยาลัยขอนแก่น ในปีการศึกษา 2538 และเข้าศึกษาต่อในหลักสูตรวิศวกรรมศาสตรมหาบัณฑิต ที่จุฬาลงกรณ์มหาวิทยาลัย ในปีการศึกษา 2539